UTS UNIVERSITY OF TECHNOLOGY SYDNEY

The Manifestation of Positive Computing in the Aged Care Workforce

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the degree of

Doctor of Philosophy

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Declaration of Originality

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Patrick Shearman declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy in the Management Discipline Group, UTS Business School at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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Abstract

Positive computing a recently developed paradigm aspires to design and develop technologies to support wellbeing and human potential in the workplace, as opposed to the traditional technology paradigms that focus on realising benefits such as productivity and efficiency gains. A lack of evidence-based research presents a challenge to understanding the potential of positive computing in improving wellbeing in the workplace.

An industry where wellbeing of the workforce is important to the sustainability of the industry is aged care. The aged care workforce needs to become highly and digitally trained to meet the current challenges and future needs of an ageing Australian population. There is little research on the impacts of technology on the wellbeing of aged care workers and no research on positive computing in an aged care context.

This study assessed the manifestation of positive computing in the aged care workforce, guided by five research questions: 1) How does positive computing manifest in the context of aged care work? 2) To what extent does positive computing affect the work outcomes of aged care staff? 3) To what extent does positive computing affect employee wellbeing? 4) To what extent does positive computing affect the provision of aged care? 5) How can positive computing promote diffusion of innovation in aged care organisations? a multi method design composed of a qualitative research study and explanatory mixed-methods study guided the research. The 148 participants were employees at a not-for-profit aged care organisation in Western Australia.

The study found promising evidence that considering technology through a positive computing lens can contribute to the wellbeing of employees due to a perception of better organisational support, and that positive computing can have benefits for aged care organisations and their workforce. Aged care organisations that put in place a supportive, social exchange culture, with high perceived organisational support, are more likely to put in place technological practices that are commensurate with positive computing. In such settings, positive computing has the ability to improve employee wellbeing and affective commitment and, to a lesser extent, a higher quality of proactive care. Positive computing is also a way to consider innovation at the frontline in aged care and can be part of the overall mix to improve carer wellbeing and effectiveness. The research findings in this study, although promising, are limited to one aged care organisation further research is required on the efficacy and utility of positive computing.

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I have always wanted to do a PhD and to teach, however my career took me in a different direction in technology for a long time. I am happy to be able to complete this thesis and I hope I will be able to progress my career in teaching and technology research in aged care and other socially complex fields where technology has potential to help address challenges.

In terms of acknowledgements, I would like to start with my parents who are no longer with us. My mother Claire, who formed a large part of my views on the benefits of education, was semi-illiterate and could not read or help me or my sisters with school homework. This was very upsetting to her so she had the courage to go back to school at the age of 40 to learn how to read and write. This transformed her and the family, making the benefits of education apparent to me at an early age. I also have to thank my father, Tommy, who was a lorry driver delivering Guinness to the pubs of Dublin. He was an intelligent man who never had the chance to study but was never bitter about it. However, he was fortunate to work for a company which had great foresight in looking after their employees and he was grateful for the Guinness policy of providing interest free loans to employees to enable their children to go to university. For this I am grateful, and I know my father took great satisfaction from seeing the benefits to me from these loans.

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List of Key Terms

Term	Definition
Gerontechnology	"An interdisciplinary field of research and application involving ... the scientific study of aging, and technology, the development and distribution of technologically based products, environments, and services" (Fozard et al. 2000, p. 332).
Positive computing	Calvo and Peters refer to the "design and development of technology to support wellbeing and human potential as positive computing" (Calvo & Peters 2017, page 2). They have proposed that "it is the ideal moment to start measuring and designing for the impact of technologies on the psychological wellbeing of the people who use them" (Calvo & Peters 2017).
Positive psychology	"Personality characteristics that psychologists think contribute to an individual's productivity. These characteristics can include a person's perception of self, attitudes toward work, ethical orientation, and general outlook on life" (Goldsmith, Veum & Darity 1997, p. 815).
Wellbeing	"the degree of satisfaction and fulfilment experienced by individuals as a result of having their needs and wants met" (Veenhoven 2012, page 333).
Carers	In the literature, this generally applies to employees of aged care organisations who directly care for residents in the aged care facilities. This includes registered nurses (RN), trainee nurses, and Cerftificates 3 and 4-qualified staff.
Aged Care Staff	For the purpose of this thesis, [directly, and indirectly] aged care staff were employees of the aged care organisation where the study was done and were directly caring for the residents in the facilities visited, including registered nurses (RN), trainee nurses, and Cerftificates 3

and 4-qualified staff. It also includes staff who were not directly involved in the care of residents but were indirectly involved, e.g., cooks, managers, and health and safety staff.

Chapter 1: Introduction

1.1 Overview

Australia is facing problems associated with a 'greying population' (Swan 2010). This reflects global trends in developed nations. The United Nations predicts that 22% of the world's population will be over the age of 65 by 2050 (United Nations Department of Economic and Social Affairs 2010, pp. 4–5). As populations age, the demand for health services inevitably increases. Since the commencement of this study, to address the significant issues facing the sector, the Australian government called a Royal Commission into Aged Care Quality and Safety in 2018. Its final report was issued in early 2021 (Royal Commission into Aged Care and Safety 2021). The Royal Commission into Aged Care Quality and Safety final report projects that the proportion of the Australian population aged over 85 will increase from 2% to 3.7%, or from 515,700 to 1.5 million, by 2058 (Royal Commission into Aged Care Quality and Safety 2021, p. 61).

In Australia, 49% of the population aged 65–75 years have five or more chronic conditions, increasing to 70% of people 85 years or over (Australian Institute of Health and Welfare [AIHW] 2012). Consequently, the proportion of the population using aged care services is projected to increase from 5% in 2008–09 to 8% in 2049–50 (Productivity Commission 2011). According to the Royal Commission into Aged Care Quality and Safety, the ratio of working age to older Australians is worsening. By 2058 there will be 3.1 people between the ages of 15 and 64 for every person 65 years or older, compared with 4.2 in 2019 (Royal Commission into Aged Care Quality and Safety 2021). A lower ratio of workers has significant implications both in terms of raising sufficient funds for the aged care sector through taxation and for employing a sufficient workforce (Royal Commission into Aged Care Quality and Safety 2021, p. 62).

The expected increase in demand from an ageing population for support from aged care services requires the care workforce to both renew and grow to twice its current size in the next three decades, from 210,000 workers in 2010 to 400,000 by 2025 (Aged Care Industry Information Technology Council [ACIITC] 2014, p. 6). If the number of workers does not grow to meet demand, then the quality of care is not likely to improve and realise the recommendations of the Royal Commission into Aged Care Quality and Safety (2021). It is imperative that research into how to expand the aged care workforce is carried out.

Research has highlighted gaps in the ways aged care organisations are managed that have been identified as causal factors in the below-par service provision of care for older Australians (Productivity Commission 2011). According to King (2007, pp. 199–212), there are a number of trends in the sector that are unsustainable. One tension is related to this study: there is an ongoing issue of care worker recruitment and retention (King 2007, pp. 199–212). This trend of ongoing workforce recruitment and retention is confirmed in the 2020 Aged Care workforce census report, which says there are currently 22,000 vacancies in direct care roles across Australia (Aged Care Workforce Census 2020). However, retaining current carers and attracting new workers is hard due to the difficult nature of aged care work (Aged Care Workforce Census 2020, p. 5) yet this will be essential in the years to come. Recent projections suggest that, in order to meet the demands and demographic changes in Australia, the aged care workforce would need to grow by 70% by 2050, increasing by 130,000 workers—a number that will be even higher if the Royal Commission's recommendations are fully implemented (Royal Commission into Aged Care Quality and Safety 2021).

The challenges of managing the aged care workforce need to be considered and addressed, as workers are critical to the sustainability of the industry (King 2007, pp. 199–212; Aged Care Workforce Census 2020, p. 5). The workforce is low skilled, low paid, casualised and dependent on immigration (Aged Care Workforce Census 2020, p. 16; Kaine 2012). Aged care providers are struggling to develop the workforce capacity they need to deal with growing service demand (Workforce Census 2020, p. 5). The aged care industry is characterised by limited funding and a workforce that is vocational and risk-averse, which contributes to a non-innovative culture (Aged Care Workforce Census 2020, p. 16; Nusem 2016). Both residential care and home-based aged care are labour-intensive and often physically demanding. Aged care workplaces are generally highly regulated, and this can lead to a general fear of litigation and an overall compliance culture (King et al. 2013; Nusem 2016; Swan 2010; Walker 2014; Weerawardena & Mort 2001).

These characteristics present major difficulties for the aged care industry in attracting and retaining workers (King 2007, pp. 199–212; Aged Care Workforce Census 2020, p. 5). The poor perception of aged care workers and aged care as a career also needs to be addressed (Farr-Wharton and Shearman, 2017). The Royal Commission report outlines the challenges related to the aged care workforce. It highlights the low wages in the sector for complex work as a key issue, along with the need to ensure aged care centres are appropriately staffed to meet

the specific needs of the older residents so that services are person-centred and of a high quality (Royal Commission into Aged Care Quality and Safety 2021, p. 124). The Commission's report states that jobs are 'inextricably linked' with the quality of care in the sector (Royal Commission into Aged Care Quality and Safety 2021, p. 124).

In one study of aged care workers (Walker 2014), valuing one's own work and a high level of self-efficacy were identified as factors mitigating the risk of work-related stress and burnout. The job related emotional resilience and energy levels required by carers to remain engaged in care work are difficult for staff to acquire in training environments (Baldwin et al. 2015). Furthermore, those who manage aged care employees are also confronted with the challenges of resource constraints, competing demands and managerial inexperience with only 8.3% of all aged care managers having postgraduate management education (Baldwin et al. 2015). These and other factors contribute to a range of key workforce challenges in the aged care industry.

1.2 Addressing the workforce challenges of the aged care industry

To address the challenges facing the workforce in the aged care industry, research is required that considers how the industry can retain and grow its care workforce to meet current and future demands and make it a more attractive industry to work in. There are many challenges facing the aged care industry discussed in both the literature and industry reports—too many to address in this thesis. The research in this thesis focuses on three areas that have potential to contribute to the addressing the challenges facing the aged care industry: innovation, technology, and carer wellbeing.

Innovation can help aged care organisations plan and transition from the current patient residential system to the future customer-focused care model. However, the concept of innovation has struggled for support in public and not-for-profit management contexts (Productivity Commission 2011). The aged care sector needs to innovate to meet its current and future challenges (Nusem 2016). Changes in the aged care industry, including the increased commercialisation of services, changes to regulation and changes in the demands of customers, have all contributed to services reviewing their operations (King et al. 2013; Nusem 2016; Swan 2010; Walker 2014; Weerawardena & Mort 2001). Despite the risks associated with innovations, this changing context means services are likely to fail if they refuse to innovate (Carlopio 2009) and innovation has become essential for services to maintain competitiveness (Chiroiu 2009; Christensen & McDonald 2018; Nusem 2016; Verganti 2009).

The second area the aged care sector can focus on is technology. To ensure the care needs of more older Australians are better managed, providers need to use the capability and future potential of information and communication technology (ICT), such as mobile devices and data analytics, to boost workforce productivity. The Aged Care Industry Information Technology Council (ACIITC 2014) acknowledged the importance of digital technology in helping address the challenges of the aged care industry, including workforce management.

To help the sector adjust to this new environment, the ACIITC (2014) identified five ICT pillars for providers to prioritise: care management systems, mobility and telehealth, eHealth systems, core technology and support, and management information and reporting. The ACIITC (2014) argued that digital technology can realise benefits across the industry. The benefits for consumers include more choice and control over the services they receive and greater independence. Providers will be able to develop business models that are more cost-effective and relevant and collaborate more effectively with other providers and government (ACIITC 2014). Benefit realisation targets set by the ACIITC (2014) include growth in clinical workforce productivity by 20% to 30% on an industry-wide basis, which translates to an additional resource capacity equivalent to approximately 45,000 additional aged care workers. This benefit can partially address the increased demand for care workers predicted by the ACIITC (2014).

The application of technology in the practice and management of aged care is maturing but more is required (ACIITC 2017). This low level of maturity is a symptom of the nature of the sector which affects the ways in which digital disruption can be implemented. Further study is necessary to understand how innovation and diffusion of innovation can occur in the fiscally constrained environment of aged care, and with minimal short-term negative effects.

A third area of focus for the aged care industry to address workforce challenges is carer wellbeing. The workplace demands on aged care staff can impact their wellbeing (Walker 2014). Care staff who are overburdened with the personal strain associated with providing emotionally draining work can quickly become disengaged, reducing their alertness and attention to changes in the wellbeing and health of those in care (Walker 2014). The average pay for aged care workers is not sufficient as a primary motivating factor to stay at an organisation (Kaine 2012). Despite the increasing demand for aged care services, including residential care facilities, the percentage of aged care recipients living in residential aged care facilities has actually decreased (Baldwin et al. 2015). This is understandable, as most people

prefer to live at home and consider residential care a last resort (Stones & Gullifer 2016). In the future, people who enter aged care are likely to have been users of home care, be in even frailer health and be in care for a shorter period of time, creating more pressure on workers. Consequently, residential turnaround, defined as the length of stay of a resident, will be shorter, creating new requirements and increasing pressure on aged care organisations and how they operate. It is likely that these changing dynamics will have a negative impact on aged care staff due to the increased complexity of residents' care needs. Aged care organisations need to explore how they can manage and support the wellbeing of aged care workers to help retain current workers as well as attract new workers to meet future demand.

The challenges emerging in the aged care sector are diverse and three areas of focus, innovation, technology and carer wellbeing, can make a contribution to help addressing them. Innovation is essential for the sector to identify challenges and make the necessary transitions from the current patient residential system to the future customer-focused care model. Technology will improve the capacity of the aged care industry to respond to the complex care needs of the increasing number of older Australians (Barnett et al. 2017, 2019; Tegart et al. 2014, pp. 4–5). However, technology needs to not just focus on productivity and efficiency gains, but should also support carer wellbeing in the workplace to reduce the demands placed on carers and to show that their employer cares about their wellbeing. By doing so, technology can potentially contribute to attracting new people to the industry and help retain current aged care workers.

Since the commencement of this study, the significant issues facing this sector have led the Commonwealth government to call a Royal Commission to address the issues and sustainability of the aged care sector. The Commission's final report released in March 2021 (Royal Commission into Aged Care Quality and Safety 2021) made 148 recommendations of which five are relevant to this study. These five recommendations are discussed in Chapter 6 in Section 6.5 Implications for practice and policy.

1.3 Research problem

The emerging challenges in the aged care sector, outlined briefly above, inform the framing of the research problems addressed in this thesis. The ACIITC (2014) recognises the importance of these central issues in their recommendations, yet the complexity of the aged care sector and the diversity of providers has meant it is an industry that is slow to adopt new technologies and

to innovate. A lack of overarching policy and strategies for the aged care sector to integrate care-supporting technologies into funding and services has led to uneven deployment of these technologies in Australia (Barnett et al. 2017). To help address this, the ACIITC consulted with the sector and published the Technology Roadmap for Aged Care (Barnett et al. 2017, p. 1). Adding to the findings of the ACIITC, a further study for the Australian Council of Learned Academies also identified a number of impediments to technology uptake in the sector, including the absence of individuals within organisations to lead organisational and policy decisions that encourage the adoption of assistive technologies (Barnett et al. 2017, 2019; Tegart et al. 2014, pp. 4–5).

This suggests that end users, in this case the aged care workforce, must be included in the development and assessment of digital tools designed for people in the aged care sector (ACIITC 2017). The Australian Digital Health Agency (2018) also produced a National Digital Health Strategy after consultations with the sector, which suggests the workforce is central to the 'diffusion of innovation' and provides strategies in which paid and informal carers receive access to free digital services (ACIITC 2019). The aged care workforce has a clear role in implementing new technologies that can make the industry more sustainable and help address the predicted demand for care workers over the next three decades. However, technology often does not address the wellbeing of the aged care workforce, as traditional paradigms focus on efficiency and productivity gains. To attract new people to the industry, technology needs to consider the wellbeing and the workload of carers while they are at work. Therefore, it is necessary to consider technology paradigms that take carer wellbeing into account rather than the traditional focus of productivity and efficiency.

One such technology paradigm that focuses on wellbeing is positive computing. For this research to contribute to the literature on positive computing, it must take into account the questions and issues raised by those researchers who have engaged with the role positive computing may have in the workplace. Pawlowski et al. (2015, p. 407) ask "How is it possible to create technology-induced changes which improve the employees' situation and are perceived as positive?". Their views have informed the development of the research questions underpinning this thesis. This research also responds to the call from Pawlowski et al. (2015) on the importance of developing new instruments that can measure the impact of positive computing. Strains associated with emotionally draining work, increasing demand, and the complexities of care work all have an impact on carer wellbeing. Positive computing has the potential to improve the wellbeing of the workforce in the aged care sector, however little

research has been done on positive computing and none on positive computing in the aged care context. This thesis explores how positive computing manifests in the aged care sector, and whether it can promote the diffusion of innovation in the aged care sector.

1.4 Research questions

Five research questions guide this study:

1. How does positive computing manifest in the context of aged care work?
2. To what extent does positive computing affect the work outcomes of aged care staff?
3. To what extent does positive computing affect employee wellbeing?
4. To what extent does positive computing affect the provision of aged care?
5. How can positive computing promote diffusion of innovation in aged care organisations?

The research questions are explored by the literature review, analysis of quantitative survey data and qualitative interviews with aged care workers.

The research design underpinning this study is aligned to the pragmatic research paradigm (Creswell & Clark 2007) and a mixed methods approach. Using a sequential explanatory approach, the first phase quantitatively collects and analyses data using a survey instrument, while the second phase qualitatively collects and analyses data using semi-structured interviews to build the depth of understanding and assist in interpreting the quantitative analysis in the first phase.

The following four hypotheses were developed from the research questions and were tested during the quantitative and qualitative research phases:

H1: Perceived organisational support is positively associated with positive computing.

H2: Positive computing has an effect on carer wellbeing

H3: Positive computing is positively associated with carers' proactive care.

H4: Positive computing is positively associated with carers' affective commitment.

1.5 Research scope

The scope of this research was defined by the design of the research methodology. The research methodology is a mixed methods explanatory study with both quantitative and qualitative phases. In the quantitative phase, there was no pre-developed instrument for testing the impact of positive computing on the wellbeing of aged care staff and consequently a new instrument was designed and tested. This research therefore responds to the previously discussed call from Pawlowski et al. (2015) to develop such an instrument. This study also contributes to the core research question of Calvo and Peters (2014), who sought to understand how changes introduced by technology in the workplace might improve employee wellbeing. This research also seeks to contribute to more recent discourse, such as that in the National Digital Health Strategy (2018), which identifies the critical role played by the aged care workforce in the diffusion of innovation. Finally, this research also addresses some of the issues identified in the recommendations of the ACIITC's Technology Roadmap for Aged Care (2017).

The scope of this thesis was also defined in terms of the data collection. Data for the quantitative and qualitative approaches was collected from aged care workers in the Western Australian not-for-profit residential aged care organisation (hereafter, the aged care organisation). The aged care organisation is one of the leading not-for-profit organisations providing aged care services in Australia. In the quantitative phase, responses were collected from 148 aged care workers in 11 facilities. The later qualitative phase included semi-structured interviews with 36 aged care workers.

1.6 Contribution to knowledge

This thesis draws from three areas of literature and research: aged care, innovation and positive computing. Innovation and technology research in an aged care context is a growing research area, but there are significant gaps in the literature for approaches to drive innovation in aged care (Numez 2016). Positive computing research is also in its infancy generally and non-existent in reference to aged care specifically. Through a review of literature, this thesis identifies gaps in the research and contributes knowledge to address those gaps. This study presents an explanatory study of a not-for-profit aged care organisation and its care staff and considers how positive computing manifests within the organisation, how it affects the care staff, and how positive computing promotes diffusion of innovation within an organisation.

This thesis is the first to explore, measure and develop a scale for assessing the effect of positive computing on the care staff of an aged care not-for profit organisation. While early drivers for technological developments were to improve efficiency and productivity, the technology industry has entered a phase that emphasises social good (Calvo & Peters 2014). The literature on positive computing is limited but has started to evolve.

However, further calls for more research into positive computing have been made. One of the key issues facing positive computing is that it is not yet widely embedded in research on information systems (Pawlowski, Jansen & Koch 2015). According to Pawlowski et al. (2015), this has led to a lack of evidence-based research to empirically measure the effectiveness of positive computing in producing positive wellbeing outcomes. While positive computing appears to have potential, further research is clearly needed. Because no such measurement instrument existed, this research developed a new survey instrument for quantitative analysis in order to measure and analyse the manifestation of positive computing in the aged care workforce. The evidence collected from the survey instrument and from the qualitative phase interviews makes a contribution to research on the positive computing paradigm and aged care workforce wellbeing.

Overall, when analysing the quantitative and qualitative data, the results indicate that manifestation of positive computing in aged care is positive and can have benefits for the aged care workforce. These results suggest that aged care facilities that have a supportive, social exchange culture, with high perceived organisational support, are more likely to put in place technological practices that are commensurate with positive computing. In such settings, positive computing has the ability to advance employee wellbeing and affective commitment, however it was not significantly associated with a higher quality of proactive care.

The qualitative study also provided more insight into difficulties and reasons for slow uptake of innovation in the industry. The benefits of technology, when examined through a positive computing lens, help to elucidate how it benefits families of residents and improves the work–life balance of workers. Supporting the overall quantitative themes, the qualitative data also produced further insights into the critical role technology has to play in job satisfaction for care staff. In short, the research findings suggest positive computing can be part of the overall mix of factors that have positive outcomes for care worker wellbeing. Moreover, positive computing is a way to look at innovation at the frontline of aged care.

The thesis also makes contributions to discourses on technology. By contributing to discourse on positive computing, this thesis assesses technology through the lens of wellbeing and focuses on the carers' experience of technology, rather than taking a traditional point of view that understands technology in terms of its contributions to efficiency and productivity. It highlights that care staff have a focus on the benefits of technology and by focusing on the wellbeing of carers, carers can become agents of diffusion of innovation. The research also shows that carers respond to positive technology more effectively if they see that the organisations executive or management is supporting them more and there is a strong link between technology investment and staff perceived organisational support.

1.7 Thesis outline

The thesis has seven chapters. The first three chapters present the research context, literature and methods. The following chapters outline the findings of each of the two research phases, and present the discussion and conclusion.

Chapter 1 Introduction introduced the context for this research, the key research questions and research scope, and identified the contributions of this thesis to knowledge. This overview chapter establishes important concepts and contexts that are further explored in following chapters.

Chapter 2 Literature review summarises the current research in the fields of positive computing, diffusion of innovation, aged care and wellbeing. First, positive computing is introduced, outlining the concepts and the tensions in the literature. Second, an overview of innovation, the diffusion of innovation, and the need for innovation in aged care is provided, followed by an overview of innovation in aged care and the existing tensions between innovation and aged care. Third, perceived organisational support and wellbeing are defined, and an overview is provided of the wellbeing of the workforce in aged care. Fourth, the importance of technology to the future and sustainability of aged care is provided, and existing tensions between investment in technology and the call for the aged care workforce to be agents for diffusion of innovation are explored. Finally, gaps in the research are highlighted and the four key hypotheses are listed.

Chapter 3 Methodology and research design describes the approach and design this thesis takes to research. The chapter outlines the research paradigms and the multi method research design composed of a qualitative research study and an explanatory mixed methods study with two

phases: a quantitative study followed by a qualitative study used for this thesis. The chapter then outlines the multi mixed methods approach. It details the design of the survey instrument for the quantitative phase and for the semi-structured interviews in the qualitative phases and methods of analysis, measurement and validity testing. Research ethics are also outlined.

Chapter 4 Quantitative analysis presents the results from the primary quantitative research phase. The survey completed by 148 care workers in 11 the aged care organisation in Western Australia is described. The results of the structural equation modelling analysis are provided, and the implications of the findings and their limitations are considered.

Chapter 5 Qualitative analysis presents the findings from the secondary qualitative phase which included semi-structured interviews with 36 care workers. This chapter first draws on the themes emerging from the quantitative analysis. Coding and analysis of the interview data is explained. The key themes are then explored, using the interviewees' own words to support the analysis.

Chapter 6 Discussion on findings and implications discusses the findings from each of the two phases of research. The implications of these findings are explored with reference to the research questions. The contributions to knowledge are reviewed and the chapter explores implications for further research and for practice and policy in the aged care sector.

Chapter 7 Conclusion provides a final summary of the thesis, integrates the findings and the key points of discussion, and makes concluding statements.

Chapter 2: Literature review

2.1 Overview

This chapter presents a review of the current literature on positive computing, innovation theory, technology and wellbeing in the aged care context. An overview of the current position of the literature on positive computing is provided first. The tensions in the literature and current limitations of positive computing are also discussed. The second area of focus is innovation theory and, specifically, the theory of adoption of innovation. The need for innovation in aged care organisations to address their many challenges is discussed. The third section of this literature review focuses on wellbeing and, in particular, the wellbeing of aged care staff. This chapter concludes by presenting four hypotheses, which frame the research design and methodology.

The literature on positive computing is limited but has started to evolve. While early drivers for technological developments were to improve efficiency and productivity, the technology industry has entered a phase that emphasises social good (Calvo & Peters 2014). The first literature on positive computing was presented in 2014 by Calvo and Peters, although literature on positive technology was evident in 2012 (Riva et al. 2012). Mainstream business publications were quick to identify positive computing as the 'next big thing' (Rodruigez 2015). However, further calls for more research into positive computing have been made as one of the key issues facing positive computing is that it is not yet widely embedded in research on information systems (Pawlowski, Jansen & Koch 2015). Pawlowski et al. (2015) indicated another key issue in studying positive computing and its impact on wellbeing is being able to empirically measure the effectiveness of positive computing in producing positive wellbeing outcomes. While positive computing appears to have potential, the lack of evidence-based research on its effectiveness to achieve positive wellbeing remains a limitation.

2.2 Summary of the literature on positive computing

Positive computing is developing within a broad societal trend focused on how to achieve happiness, wellbeing and a good quality of life. Humanistic values, such as achieving human potential and improving quality of life, have become the focus of many economists, politicians and policymakers as they emphasise statistical measures for happiness and not just traditional

economic indicators of success (Helliwell, Leyard & Sachs 2012). In the context of the workplace, this has led to a core research question, as raised by Pawlowski et al. (2015, p. 407): "How is it possible to create technology-induced changes which improve the employees situation and are perceived as positive?". In the information and technology sector, positive computing is one product of these trends.

These trends are largely influenced by developments in psychological research that focus on the healthy functioning of resilience, happiness and altruism. At the same time, and from a different perspective, neuroscientists are increasingly understanding the physiological benefits of positive wellbeing and the roles mindfulness, empathy and meditation can play. These developments have been embraced in the fields of education and business by professionals wanting to apply emotional intelligence and positive psychology to improve outcomes in schools and workplaces (Joinson et al. 2007; Ong & van Dulmen 2006). By focusing on applying technology to support happiness, wellbeing and positive psychology, positive computing contributes to these broader trends.

Humanistic approaches to technology design have expanded in the last 10 years due to the phenomenon of innovation and digital technology disruption, leading to new technology paradigms. Although historically technology has been used to develop and change the systems and processes of organisations to improve efficiency and productivity (Calvo & Peters 2014), these new humanistic paradigms tend to focus on other factors. Terms that are frequently used include positive computing, positive technology, experience-centred design, positive design, and value-sensitive design (Botella et al. 2012; Calvo & Peters 2014; Faust 2009; Friedman 1996; Gaggioli et al. 2017; Riva et al. 2012; Wright & McCarthy 2010).

Positive computing was defined by Calvo and Peters (2014, p. 2) as "the design and development of digital technologies to support wellbeing and human potential". It is informed by positive psychology, which is strengths-based and promotes wellbeing and flourishing rather than focusing on deficits (Seligman & Csikszentmihalyi 2000). To enable people's potential rather than focusing on their deficits, positive computing uses innovative technologies to promote positive mental health outcomes like improving empathy in the workplace. Positive computing frames wellbeing and strength explicitly as issues within the discourse of digital design. Improvements in wellbeing have been shown to influence employee performance (Truss et al. 2013). As Gaggioli et al. (2017) indicate, Riva and colleagues have successfully demonstrated the approach in cyber psychology (Carissoli, Villani & Riva 2015; Gaggioli et

al. 2014; Munson & Resnick 2012; Villani et al. 2013; Wiederhold & Riva 2012), which seeks to understand the impacts that digital technologies have on individual psychology (Gaggioli et al. 2017; Riva et al. 2015).

Positive computing and positive technology are often discussed together, though they differ slightly (Gaggioli et al. 2017). They are also discussed in conjunction with designing for wellbeing, positive design and "possibility-driven" design (Desmet & Hassenzahl 2012; Desmet & Pohlmeyer 2013; Diefenbach 2018; Diefenbach et al. 2017). Although different, each of these approaches has a shared goal to improve wellbeing through the design of technologies.

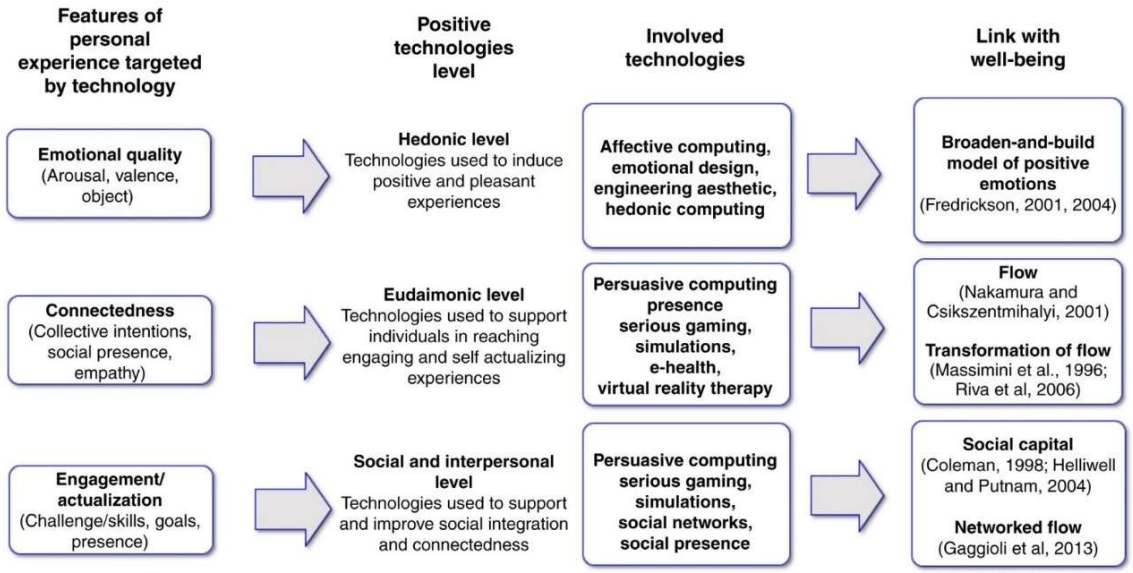
One of the key approaches in positive computing is to develop processes that have positive effects on the organisation and individual workers (Calvo & Peters 2014). This includes strategies that build workers' wellbeing and require an organisation to assess itself based on the wellbeing of its staff. This approach also means that processes such as change management should also be part of adopting new systems and processes, so the staff can have adequate support in adapting to change (Calvo & Peters 2014). Process developments should also start from a positive position, building on the strengths of an organisation rather than addressing barriers, refusal and fears. Again, this raises the important question of how "to create technology-induced changes which improve the employees' situation and are perceived as positive" (Pawlowski et al. 2015, p. 407).

As well as the two key trends informing positive computing – the focus on user experience and the emergence of positive psychology – three critical variables have also been identified by Gable and Haidt (2005): affect regulation, engagement and actualisation, and connectedness, also known as emotional quality, presence and flow, and collective intentions and networked flow respectively. Each helps to design positive technologies (Inghilleri, Riva & Riva 2015). An early example of how these variables have been deployed was cybertherapy (or e-therapy), where people received mental health support online rather than through traditional engagement with the health system. This was the first area of cyber psychology to influence psychological treatments (Manhal-Baugus 2001).

In theorising positive computing, Riva et al. (2015, p. 551) focused on design that improves wellbeing, resilience and strengths in individual users as well as more broadly in organisations

and society. They developed a framework (see Figure 2.1) to classify the impacts of technologies on personal experience (Botella et al. 2012).

Figure 2.1 Positive technology framework (Gaggioli et al. 2017)



Source: Gaggioli, Riva, Peters & Calvo (2017).

According to this framework, there are three levels at which positive technology works: the hedonic, eudemonic and social/interpersonal levels.

At the hedonic level, technologies are designed to create generally pleasant or positive emotions. Wearable and virtual reality technologies have demonstrated the potential to decrease stress and provoke emotional responses that are positive (Gaggioli et al. 2017, p. 493; see also Grassi et al. 2009).

At the eudemonic level, technologies are designed to induce 'self-actualizing experiences' (Gaggioli et al. 2017, p. 492). These tools support personal growth through engaging, mediated experiences, for example, by crafting tailored virtual reality environments that optimise outcomes in training and education (Gaggioli et al. 2017; see also Botella et al. 2004, Riva 2007).

At the interpersonal or social level, "technologies are used to support and improve social integration and/or connectedness between individuals, groups, and organizations" (Riva, Calvo & Lisetti 2015, p. 551). This includes systems and tools designed to improve social interactions and connections, such as tools designed to decrease isolation among older residents in aged

care facilities (Gaggioli et al. 2017, p. 492; see also Morris et al. 2013) or to improve communication between young people and older people (Gaggioli et al. 2014). The theories of wellbeing used by Gaggioli, Riva, Peters and Calvo (2017) were used in the development of this research survey instrument.

2.2.1 Determinants of wellbeing in positive computing

Calvo and Peters (2015) used several widely accepted determinants of wellbeing for interaction designers and human–computer interface researchers to help them determine psychological wellbeing in relation to their design (Gaggioli et al. 2017). These included autonomy, competence, relatedness, compassion, meaning and engagement.

This study by Calvo and Peters (2015) identified six determinants of wellbeing against the theories and the research underpinning them. The first is competence, or the sense of having the necessary experience or capacity for a given situation (Huppert & So 2013; Ryan & Deci 2000). The second is autonomy, or the sense of having the capacity to have an impact on a given situation (Huppert & So 2013; Ryan & Deci, 2000). The third is relatedness, or a sense of belonging, secure relationships, and connection with others (Ryan & Deci 2000; Ryff & Keyes 1995; Seligman 2002). The fourth is engagement, or the capacity to take part in absorbing activities that encourage and maintain concentration (Seligman & Cziksentmihalyi 2000, 2014). The fourth is compassion, or an awareness of the negative emotional experiences of others that motivates an individual to act (Gilbert 2012; Gotz 2017, Hall & Goetz 2013; Goetz, Keitner & Sinon-Thomas, 2010). The final determinant is meaning, which is the degree to which one feels fulfilment when drawing on one's capacities and skills usually in relation to a purpose greater than oneself (Ryff & Keyes, 1995); Seligman 2002).

Because of the broad reliance on information technologies by organisations, individuals, society and industries, positive computing has the potential to support the determinants of wellbeing in a broad range of contexts. However, the research field remains undeveloped and this is one of the key areas of tension that must be considered within the literature. The survey instrument developed in this thesis was based on previous surveys for the six determinants of wellbeing in positive computing.

2.3 Tensions in the literature on positive computing

This section reviews the tensions in the literature on positive computing. Given the field of research into positive computing is relatively new, there is little research and discussion on critiquing the paradigm. This generates some key tensions in the literature: overselling the potential of positive computing, the lack of research in the field, and the lack of empirical evidence or measurement scales, as discussed below. As well as positive technology's general potential, Diefenbach (2018, p 9) also expressed concerns about the "particular challenges and shortcomings within current approaches taken to employing new technologies to improve technology-mediated support of wellbeing and aid change". Some of the areas of "positive change" Diefenbach (2018, p. 9) suggested focusing on included designing a stable dialogue, accessing the target group, disregarding insights through inactivity, disregarding psychology during technology design, and considering the limits of humanistic and human-centred approaches, backfire effects and user predispositions. The issues most relevant to this research are discussed in more detail in the following sections.

2.3.1 Overselling the potential of positive computing

One important issue in the literature on positive computing is a tendency to make claims about its potential that are not yet supported with evidence. For instance, mainstream business publications have claimed positive computing as the "next big thing" (Rodruigez 2015).

Positive computing stems from the view that technological devices can support psychological and physiological health as well as factors impacting health, such as self-regulation and learning. These benefits have been explored in numerous contexts in human–computer interface and "psychological research" (Bouvier, Hinz & Schmidt 2016; Diefenbach 2018; Monkaresi et al. 2013; Niess & Diefenbach 2016). However, some approaches have taken an optimistic or even utopian perspective of the potential of these technologies (Negroponte 1996; Robertson 1998) and a realistic view is required based on rigorous research.

According to Pawlowski et al. (2015, p. 408), there are great benefits of including "business and information systems engineering" into the "research and development of information systems". The potential of positive computing is in its possible applications in a range of contexts in which information systems are presently ubiquitous, such as the healthcare industry, and combining them with an emphasis on wellbeing (Riva et al. 2012). However, although the

comments from Rodruigez, Pawlowski and Riva are supportive of positive computing and its potential, they also highlight that the research field remains undeveloped, which is an issue that needs to be addressed. Without further research into positive computing, there is a risk that overselling the potential of positive computing could lead to false expectations. This tension was explored in the both the quantitative and qualitative research analysed in this thesis in order to assess the potential of positive computing and whether it has been oversold.

2.3.2 Lack of research in the field

Claims made about the potential of positive computing are at times overstated because of the lack of research in the field. Pawlowski et al. (2015) also identify this tension, saying that positive computing is not yet widely embedded in research on information systems. It has been noted that technology presents an opportunity to implement positive changes, but the challenge remains in determining how to achieve them (Diefenbach 2018; Kanis & Brinkman 2009, p. 127). Further understanding just how technology-induced changes might create positive change, particularly in a workplace context, remains a core research question in positive computing (Calvo & Peters 2014).

In order to expand research in positive computing, interdisciplinary research that draws together positive psychology and information systems is needed (Pawlowski, Jansen & Koch 2015). This research needs to reconsider current information systems models, and could be broadened to include metrics that extend beyond ease of use and instead include both organisational performance and individual wellbeing (Pawlowski, Jansen & Koch 2015). A key goal of this thesis is to make a contribution to the research of positive computing and answering Pawlowski's call to embed positive computing into research on information systems (2015).

2.3.3 Lack of empirical evidence or measurement scales

As positive computing technologies are intended to change behaviour, "the effectiveness of change must be measurable" (Lee et al. 2018). However, because of the relative newness of the field, an empirical framework of scales to measure the effectiveness of positive computing has not been developed and tested.

Pawlowski et al. (2015, p. 406) acknowledge that one of the key issues in studying positive computing and its impact on wellbeing "is determining the appropriate scales to use in order to assess impact and outcomes". For example, "flourishing" (Diener et al. 2010) and "satisfaction with life" (Pavot & Diener 2008) scales – both commonly used and validated in other contexts – have been proposed as a base from which to develop a broader measurement for positive computing (Pawlowski et al. 2015). However, these scales have not been widely adapted and tested in positive computing. To help address this lack of tested scales, randomised control trials have been suggested as the most effective method to assess the efficacy of positive computing systems (Bert et al. 2014; Oinas-Kukkonen 2013). This also helps ensure the scales are more acceptable to users (Kelders et al. 2012; Stephens & Allen 2013).

An empirical and systematic analysis of the potential of positive computing is required to provide a more complete picture. This would help answer the research question of Calvo and Peters (2014) to develop further understanding on just how technology-induced changes might create positive change, particularly in a workplace context, a core research question in positive computing. A key objective of this thesis is to develop a scale to measure the affects of positive computing and make a contribution to the empirical body of evidence.

2.3.4 Accessing the target group (the users) and machine user view

Stibe (2016) provides a helpful taxonomy of how technologies are adopted, which reflects on the primary target group of positive technologies. Stibe (2016, p. 44) identifies three types of people in pursuing personal change: the "self-driven", with comparatively high levels of internal drive to make improvements; the "self-contained", who are not motivated to change because they are satisfied with their current condition; and the "January 1st" people who, despite recurring motivation, rarely succeed in making change (Diefenbach 2018b). Designing positive computing "must be targeted to at least the latter group, for whom positive technologies could be a determining factor that enables change" (Diefenbach 2018a, p. 10).

To access the target group of users, designers must also take into account the broader social attitudes towards developments in new technology. In the dissemination of new technologies and their impacts on wellbeing, there are thought to be four broad categories of users (Diefenbach 2018): the "positive dogmatic" user believes technological progress is inherently beneficial, leading to more wealth, education and better health and wellbeing; the "negative dogmatic" user believes that new technologies inevitably lead to unemployment and ill-health;

"agnostics" prefer to wait and see the impact of new technologies or question the validity of measuring wellbeing; and finally, the "sceptics" raise questions about the concept of wellbeing itself. Designing new technologies must take into account these types of users. It will always be more challenging to convince a negative dogmatic user or a sceptic to use to adopt a new technology in the workplace than a positive dogmatic user. Some techniques, like integrating new technologies into existing organisational processes or simplifying user design as much as possible, help to reduce barriers expressed by resistant users. This thesis has indentified Australian residential aged care staff as the target user group in which to research positive computing.

2.3.5 Disregarding psychology during technology design

Another challenge remains the lack of co-operation and communication between positive psychology researchers and technology designers. Research in the fields of wellbeing and positive psychology frequently fails to consider the potential of technology (Diefenbach 2018). Botella et al. (2012, p. 82), for example, note that most manuals for positive psychology do not mention the role digital technology can play. As Diefenbach argues, even when technologies are acknowledged as contributing to change, the potential offered through dynamic elements and interactivity is often ignored (Diefenbach 2018a, p. 10; see also Baños et al. 2017; Mohr et al. 2013).

While there has been research into how technology can regulate positive emotions (Hassenzahl & Beu 2001), some designers maintain a 'machine view' of users. This hesitance to embrace positive technology stems from a scepticism about engaging with psychological issues like wellbeing. This reluctance is appropriate, as the complexities of human psychology must be approached with sufficient experience and methodologies or else negative impacts are likely. This thesis seeks to make a contribution to further research and careful design in positive computing, which can help to produce behaviour-changing technologies that take these complexities into account and improve wellbeing for users.

2.3.6 Negative effects

Information technologies have a reputation for having a "dark side" (Tarafdar et al. 2015) as they are seen as causing fears, addictions or similar negative behaviours. Biswas-Diener (2010) explores how positive psychology can have a "dark side" and the efforts to make positive

change can in fact elicit the opposite outcomes. In these cases, rather than being a source of motivation and inspiration, an idealised sense of self triggers feelings of anxiety or frustration (Diefenbach 2018b, p. 13). For example, research on the negative impacts of Facebook on its users' wellbeing demonstrates the possibility of unexpected negative consequences (Kross et al. 2013). The specific concerns raised in the research include technology dependence, abandonment and side effects (Epstein et al. 2016; Lee et al. 2019, p. 18).

Some of these challenges arise from the human-centred approach, including how "to find the right level of positivity". It may not aid an individual's ability to manage, regulate and strive for change if they are offered an overly optimistic view of their capacity to change (Diefenbach 2018, p. 13). An over-emphasis on positive elements may be considered dysfunctional. Comparing the ideal self against reality is a necessary part of self-reflection and personal growth; however, it is also a process that can lead some people to feel demotivated rather than inspired (Biswas-Diener 2010, p. 47). Confronting goals can be overwhelming, even where they are considered worthy and positive, and this must "be taken into consideration in the design of behavioural change technologies" (Diefenbach 2018, p. 13).

Calvo and Peters (2014, 2015) have also noted that the productivity mentality is another factor that should be considered in the design of positive technologies. While measuring performance can be useful as a tool for personal reflection and improvement (Rivera-Pelayo et al. 2012), the "tyranny of productivity" (Gaggioli et al. 2017, p. 493) can have negative impacts on the wellbeing of those seeking positive change.

These backfire effects have been explored in reference to gamification, that is, building elements that are playful into technologies to encourage their use (Diefenbach 2018). Gamification has been applied in non-playful contexts like health, education and finance to encourage desired behaviours. Research has responded by critiquing the impacts of specific game elements (Deterding 2014) and analysing how gamified elements can encourage behaviour changes in ways that were not intended, such as by encouraging an over-reliance on the game (Müssig 2017). Müssig (2017) identified features that rewarded negative behaviours or de-motivated positive ones. Platforms and tools targeting improved wellbeing may be well-intentioned but the efficacy of such platforms must be demonstrated with appropriate research. A research goal of this thesis is to explore the negative effects of technology during interviews with care staff during the qualitative phase of research.

2.3.7 User predisposition

In the design of behaviour-changing technologies, it is important to account for users' predispositions and the difficulty of changing routines. Where no human coach is present, behaviour-changing technologies can be easily ignored, thus requiring users to have a high level of self-discipline to change routines. If the behaviour-changing technology does not use coercive elements or strict instructions, this places the responsibility to remain committed to change on the user (Diefenbach 2018).

Research by Gouveia, Karapanos and Hassenzahl (2015) analysed the use of an activity tracker over ten months. They suggested that only highly motivated and "self-driven" users with skills for self-improvement continue to use the technology. How such motivations and other limiting factors will be taken into account, especially given the experience of users in an aged care context, remains to be seen given the research yet to be done in this field.

In using new technologies, Australians are considered to be early adopters (Barnett et al. 2017, p. 37, 2019, p. 50). However, this feature of Australian consumers is not necessarily reflected among older Australians who have been introduced to digital technologies later in life (ACIITC 2017, 2019). The willingness of older Australians to adopt new technologies will be determined by "their perceived need for that technology" (Barnett et al. 2019; Peek et al. 2014, p. 242). However, uptake rates of new technologies by older users are reduced when the users have not been included in a co-design process (Barnett et al. 2019; Winn & Nisbet 2015, p. 4).

Technology uptake is a dynamic process in which factors that encourage or inhibit it interact (ACIITC 2017). For example, increased independence might be weighed against the cost of a new technology. The ways in which these motivators and inhibitors influence each other vary from one user to the next. It is therefore "necessary to both tailor technologies to the needs and circumstances of individuals and to engage end users in a co-design process"(Australian Communications and Media Authority 2015). A research goal of this thesis is to explore the predisposition of care staff to technology using a survey in the quantitative phase and during interviews in the qualitative phase of research.

2.4 Current research in positive computing and future directions

2.4.1 Current research in positive computing

A recent literature review by Lee et al. (2018) acknowledged that positive computing has been aided by the development of wearable technologies and the internet of things (IoT). Given that many disciplines inform the positive computing literature, a holistic overview of the field is challenging (Lee et al. 2018). The literature review by Lee et al (2019) suggested six 'core' areas in design for positive computing: "design methodologies, mobile platform design, behaviour marker detection, opportune moment detection, device and modality selection, and evaluation methodologies" (Lee et al. 2019, p. 9). A scenario-based design method (Carroll & Rosson 2003) targeting college students as early adopters of new technologies was used to offer practical, if preliminary, insights into how positive computing might be implemented (Lee et al. 2018).

The researchers developed a conceptual framework for the delivery of intelligent positive computing tailored to specific audiences (Lee et al. 2019). The model followed the 'five I's': in situ (part of the user's daily life), intelligent (capable of monitoring incoming data and responding in ways that are likely to achieve outcomes), in time (interventions come at a time when a user is likely to react to them), intimate (provided in a way tailored to the specific user's configuration of devices and patterns of behaviour) and incorporating (the user is continuously part of the improvement of the system designed for their use) (Lee et al. 2019).

Because of the complexity of human behaviour that includes a wide array of internal and external factors (Proctor & Van Zandt 2018), the literature has been distilled into seven factors that influence whether a user is likely to change their behaviour: "perceived susceptibility, perceived benefit, self-efficacy, incentives, social pressure, personality, learning history" (Lee et al. 2019, p. 18). These seven factors must be considered for positive computing to be successful.

Despite research into the ways in which users can be motivated into behavioural change, users may have considerable resistance. This may include a lack of motivation, resistance to change in general, and resistance to complying with the activities needed for change. In more acute cases of psychological need (Christensen, Griffiths & Jorm 2004; Coyle et al. 2007), these approaches share a fundamental acceptance of the flexibility, sensitivity and responsiveness of

human behaviour (Sallis, Owen & Fisher 2015) as well as the importance of human agency (Crawford 1977). The design approach required to overcome user resistance must consider these factors of flexibility, sensitivity and responsiveness for the successful adoption of positive computing (Lee et al. 2019).

Researchers have suggested four scenarios to explore the conceptual model of positive computing and how it might be implemented to make slight improvements to wellbeing: "route recommendation, micro-break and user-generated content, user status confirmation, and daily reflections and goal-setting" (Lee et al. 2019, p. 18). The research focus of this thesis hopes to make a contribution to research on how positive computing can overcome user resistance by exploring the manifestation of positive computing computing in the aged care workforce.

2.4.2 Future research directions in positive computing

In terms of the use of evidence in the design of positive computing, Lee at al (2019 p 18) made suggestions for research directions. Researchers into positive computing have tended to rely on theories relating to motivation and human behaviour to understand these factors (Kraut & Resnick 2012). Ongoing and iterative testing is needed in both the short term and long term into the efficacy of platforms to better understand and design platforms in future.

Positive computing must be evaluated. In terms of evaluation, the researchers drew on the American Psychiatric Association's mental health app evaluation model. This model identifies evidence as an essential factor for ensuring privacy and security, ease of use, and achieving mental health outcomes (Lee et al. 2019; Zagorski 2017).

The effectiveness of a system may be assessed by looking at the specifics of the user experience. For instance, a deeper understanding of how and why users make use of a system may help to identify future design opportunities and challenges, and could also help to design tailored messaging specific to each user to optimise the effectiveness of the system (Lee et al. 2019, p. 18).

Improving staff wellbeing is a complex goal for organisations and technology alone is unlikely to achieve the outcome. A key approach that requires further research is for organisations to ensure their processes are designed to achieve positive impacts for both the organisation and the organisation's stakeholders, such as employees, shareholders or customers. Process developments must take a different approach; process developments should take a positive

approach from the outset rather than developing processes to address doubts and anxieties, refusal and barriers (Pawlowski et al. 2015, p. 407). This leads to a core research question that must be addressed: "How is it possible to create technology-induced changes which improve the employees' situation and are perceived as positive?" (Pawlowski et al. 2015, p. 407). This research seeks to respond to this question by exploring the manifestation of positive computing computing in the aged care workforce and developing a new scale to measure the manifestation of positive computing.

2.5 The need to innovate and diffusion of innovation

This section explores an innovation theory relevant to aged care – diffusion of innovation. It then discusses the literature on innovation and technology in the aged care industry and barriers to the adoption of innovation and technology in the Australian aged care industry. Innovation, as an economic and social phenomenon, has always existed (Fagerberg 2003). The concept is complex and crosses multiple disciplines (Smith et al. 2008). Despite the complexity, innovation is an important capability for organisations to survive and thrive, particularly in industries with continual and fast change (Hajkowicz et al. 2016).

The aged care sector needs to innovate to meet its current and future challenges (Nusem 2016). Changes in the aged care industry, including the increased commercialisation of services, changes to regulation and changes in the clients have all contributed to services reviewing their operations (King et al. 2013; Nusem 2016; Swan 2010; Walker 2014; Weerawardena & Mort 2001). Despite the risks associated with innovations, this changing context means services are likely to struggle if they refuse to innovate (Carlopio 2009) and innovation has become essential for services to maintain competitiveness (Chiroiu 2009; McDonald 2007, pp. 257–258; Nusem 2016; Verganti 2009).

Innovation research acknowledges that while the need to innovate might be well understood, change is often viewed as challenging, uncertain and even painful at both the individual and organisational levels (Cain & Mittman 2002). To address concerns at the individual level, organisations must also continually communicate to employees the importance of improving the way services are provided and adapting to clients' demands (Bucolo & Matthews 2011; Chenhall et al. 2011).

Overcoming concerns at the organisational level is complex, especially given the diversity within the aged care industry. Models for innovation often vary depending on whether an organisation is in the non-profit, for profit or public sector (Albury 2011; Borins 2001; Huarng & Yu 2011; Moore 2000; Mulgan & Albury 2003; Nusem 2016; Weerawardena & Mort 2001, 2012). Non-profit organisations tend to be risk averse (Nusem 2016), and in the aged care sector it is typical for change to be incremental in order to mitigate risk (Lenssen et al. 2007). In both the public and not-for-profit sectors, innovation is also often viewed as being outside of core business (Morris, Kuratko & Covin 2011; Mulgan & Albury 2003; Nusem 2016).

Australia's National Digital Health Strategy (2018), developed by the Australian Digital Health Agency, recognises the aged care workforce as essential in the diffusion of innovation and suggests strategies to improve access to digital technologies for both informal and professional carers (ACIITC 2019). Innovation in aged care will be explored as part of this thesis through interviews with aged care staff as part of the qualitative phase.

2.5.1 Diffusion of innovation

The aged care industry has struggled to innovate (Productivity Commission 2011) so it is important to examine innovation theories that can improve the rate of innovation in aged care. A critical factor for the success of innovation is the adoption of an innovative product or service. Everett Rogers studied adoption behaviours in innovation and developed the concept of the diffusion of innovation (Rogers 1962, 2003). This concept states that there is a pattern to uptake or adoption by users that can be applied to any innovation. Adoption starts with a group of users who are innovators who adopt the product quickly. This group, called "early adopters" or "opinion leaders", is small – about 14% of all users. Momentum starts to build and the rate of diffusion grows as more users start to adopt, forming the "early majority" (35% of users) followed by the late majority (35%) and then the laggards (16%).

Regarding the adoption of innovation in aged care, Kapadia et al. (2015) argued that it is necessary to examine all the actors in the adoption of technology in aged care: the patients, family, carers and leadership in aged care organisations. For technology to be successful in enhancing aged care service provision, an open innovation approach using many different technologies across many disciplines and with trained workers is critical. Aged care workers are key to the successful use or adoption of technology in aged care facilities – not only as users but as influencers for the elderly (Robben et al. 2012). This has been reinforced by the

National Digital Health Strategy (2018) which recognises the aged care workforce as critical to the diffusion of innovation in the industry.

There are many reasons for the slow uptake of potentially beneficial technologies. At the organisational level, funding is a key issue. Technology can bring benefits but is not necessarily cheaper and for most aged care organisations who rely on government funding, the capital to invest in technology may not be available (Postema, Peeters & Friele 2012). These factors, which relate both to the technology in question and those adopting it, include education and technological backgrounds, health conditions, reliability, design and social stigma (Kapadia et al. 2015). Some aged care workers feel that robots could take over their jobs (Broadbent et al. 2012, p. 117). One strategy to manage these concerns is to slow down the uptake of technology, which helps provide a positive experience with technology and significantly increases the chances of a strong uptake by staff (Blaschke, Freddolino & Mullen 2009).

Ensuring the aged care workforce is confident in the use of new technologies is a key challenge (Tegart et al. 2014, p. 34). Aged care staff face a number of barriers in the effective use of technology. These include negative attitudes toward new technologies and low levels of digital literacy (Davis, Morgans & Burgess 2016, p. 10). To address these barriers, investment in training and development of the workforce is required to ensure aged care staff understand new technologies and incorporate them into their models and practices and workflows (Barnett et al. 2017; see also Loh, Flicker & Horner 2009, p. 408).

For innovation to be successful, the innovation process needs to involve actors at all levels of the organisation. 'C-suite' executives and low-level staff all have a role to play in an organisation's innovation strategy. An innovative idea can originate at any level of an organisation. Saari, Lehtonen and Toivonen (2015) refer to idea generators as "top down" and "bottom up" sources. Top down describes innovation originating with senior members of an organisation (Windrum 2008). A top-down approach can demonstrate good leadership from senior members of an organisation, but it can also restrict innovation by over-emphasising innovation management as a structured and rational process (Asheim & Isaksen 2002). However, a bottom-up approach is also important, as it helps break down any rigid top-down culture and aligns to concepts of open innovation (Chesbrough 2003).

2.5.2 Innovation theory and the Australian aged care industry

The literature emphasises that innovation is critical to the sustainability of the aged care industry and wellbeing of aged care workers (Bucolo & Wringley 2015; Clune & Lockrey 2014; Weerawardena & Sullivan-Mort 2001). Despite this, the "innovation" concept has struggled to gain traction in public and not-for-profit management contexts (Productivity Commission 2011). For aged care organisations to maintain innovation and change, care staff must understand the necessity for ongoing improvement and adapt to the needs and demands of residents (Nusem 2016; see also Bucolo & Matthews 2011; Chenall et al. 2011). An important government-driven change that requires aged care organisations to innovate is consumer-directed care (Department of Social Services 2012).

Tidd and Bessant (2009) have stated that "the need for innovation is imperative" and the intent within the statement is relevant to the aged care sector. If Australian aged care organisations do not or cannot adapt to consumer-directed care, which requires innovation in order to be implemented, then some of these organisations may struggle to survive while others may struggle to cope with the increased demand for their services. As Carlopio (2009) has noted, while innovating does not guarantee success, the reluctance to do so can be disastrous. Aged care organisations who refuse to adapt to the consumer-directed care model should be aware of this.

There is evidence that aged care organisations are starting to innovate to meet the needs of the changing market. The South Australian Innovative Hub (2014) was a trial that used an 'earned autonomy' approach to improve outcomes for residents in Australian aged care services (Department of Health 2014, np). Different types of innovation were evident in the Hub trial. Process innovation led to improved quality indicators, such as a 13% reduction in bed falls, and product innovation saw overall residential aged care product improve and family satisfaction levels increase. Incremental innovation as defined by Christensen (1999) was evident through gradual improvement in the quality indicators. Business model innovation, defined by Davila, Epstein and Shelton (2006) as how companies produce, sell and deliver value most importantly was evident in how the Hub enabled collaboration between industry, government and the community to improve older people's quality of life (MP Consulting 2016).

Technology innovation is also being observed in the growth of on-demand services and the platform economy is opening new opportunities to disrupt the traditional paradigms of aged care (Hampson 2015). The 'smart' living market has changed the impacts of technology on everyday life and transformed the provision of services, including in the health and aged care sectors (ACIITC 2017). Some service providers, such as Kincare, Dialanangel and United States company Home Care Assistance are already emerging in Australia, offering on-demand and technology-based care services and disrupting the industry (Hampson 2015).

2.5.3 Technologies and their impact on aged care

In its technology roadmap for aged care in Australia, the ACIITC (2014, 2017; Barnett et al. 2017, 2019) acknowledged three meta-influences that will fundamentally change the way in which older Australians are supported, bringing both challenges and opportunities to the aged care sector: population ageing at a rate never before experienced; the development of new technologies at an increasing pace; and sector reform in aged care (ACIITC 2014, 2017, 2019). Central to all three is the consumer, consistent with the Australian government's consumer-directed care policy on aged care.

Barnett et al. (2017) also recognised how aged care will be disrupted, highlighting the disruptive technologies shaping people's lives and how they will affect aged care. The internet of things is a key enabler in smart homes for the elderly (Barnett et al. 2017). Christensen & Bower (1995) described how disruptive technology can transform industries. Technologies such as Uber services and, in the context of aged care, home monitoring devices, have enabled consumers to undertake tasks considered impossible a few years ago. Karimi and Walter (2015) suggested that technology is considered disruptive when it is used to generate products and services that an organisation's current customers do not yet value.

All organisations are affected by the competitive disruption caused by the adoption of digital technologies (Fitzgerald et al. 2013; Gerth & Peppard 2016). Weichart et al. (2016) stated that incumbents will need to transform themselves into digital enterprises to survive. Aged care is a service industry providing personalised services intended to improve the quality of life and, as a service industry, it is not immune from this disruption. The McKell Institute recognised this, arguing that the service-based economy in Australia will be impacted by new technologies in ways that are both negative and positive, and that this creates new opportunities that could benefit Australia's ageing population (2015, p. 31).

2.5.4 The slow adoption of technology in Australian aged care

The complexity of the aged care sector and the diversity of providers has meant it is an industry that is slow to adopt new technologies (see Section 2.7). A lack of overarching policy and strategies for the aged care sector to integrate care-supporting technologies into funding and services has led to uneven deployment of these technologies in Australia (Barnett et al. 2017). In order to assess the level at which technology was embedded in the operations, provision of care, and other internal organisational processes of aged care providers, the Aged Care Technology Benchmark Survey was developed by the ACIITC in 2014. The survey demonstrated that in applying technology to the provision of care, the sector had low levels of readiness (ACIITC 2014). It found there was a lack of leadership in the implementation of digital technologies in the sector, but despite a lack of implementation and engagement around 75% of organisations in the sector were interested in adopting new technologies (Barnett et al. 2017). The report also found that significant progress was needed to implement technologies in consumer-directed aged care (Barnett et al. 2017; Livingstone 2014).

Davis, Morgans and Burgess (2016) also reviewed the research on digital technologies in the Australian aged care sector between 2008 and 2014 (see also Barnett et al. 2017). In the aged care industry, organisational resources, commitment and ongoing training and support are all necessary to overcome barriers such as poorly designed and insufficient information systems and processes (Davis, Morgans & Burgess 2016, p. 10). A further challenge emerges when individuals seek services from both the health and aged care sectors, and the ways in which these sectors intersect, collaborate and share information (Barnett et al. 2017).

Adding to the findings of the ACIITC, another study also identified a number of impediments to technology uptake in the sector. On behalf of the Australian Council of Learned Academies, Tegart et al. (2014) identified a number of impediments, including technologies that do not match the needs of users or are challenging to use. Other barriers included insufficient leadership for implementation, a lack of encouragement or incentives for care workers, and poor integration across developers, government and care providers, among others (ACIITC 2017, p. 50; Tegart et al. 2014, pp. 4–5).

Table 2.1 Factors encouraging or inhibiting adoption of technology

Factors encouraging adoption	Factors inhibiting adoption
Expected benefits from using technology	*Concerns about technology*
• Increased safety	• High cost
• Perceived usefulness	• Privacy concerns (e.g. video monitoring)
• Increased independence	• Forgetting or losing technology
• Reduced burden on significant others	• Burdening significant others (e.g. needing assistance to use technology)
Need for technology	• False alarms
• Perceived need for technology	• Ineffectiveness (in addressing need)
• Subjective health status	• Obtrusiveness (linked to stigma, see below)
• Technology will enhance safety and security	• Stigmatisation as 'old' or 'ill' (design issue
	• Impracticality
	• Low ease of use
	• Negative effect on health
	• No control over technology (e.g. to switch on/off)
	• Difficult to access
Individual characteristics	*Individual characteristics*
• Desire to age in place (attachment to home, local neighbourhood)	• Physiological limitations (e.g. limited manual dexterity, sensory deterioration)
• Confidence to use technology	• Cognitive limitations
• Technological literacy	
Social influences	*Social influences*
• Family and friends encouraging	• Family and friends discouraging
• Professional service providers encouraging	• Professional service providers not encouraging
• Use by peers	• Absence of peer role models for usage

Sources: Barnett et al. (2017, 2019).

In reviewing the aged care sector, the ACIITC (2017) made a number of value statements to guide the implementation of new technologies in the aged care sector. The ACIITC (2017, p. 16) suggests that the design of new technologies intended for the aged care sector must be designed, developed and evaluated with the contribution of the aged care workforce as end users. The ACIITC (2017, p. 16) also argues that the use of technologies must be incorporated into processes and policies of the sector as well as care practices themselves. The workers are central in a network of stakeholders, including technology developers, aged care residents, their supporters and researchers (ACIITC 2017, p. 46). Innovation in aged care and the factors inhibiting innovation in aged care organisations will be explored as part of this thesis through

interviews with aged care staff as part of the qualitative phase.

2.6 The role of the aged care workforce in diffusion of innovation

According to the Australian Digital Health Agency's National Digital Health Strategy (2018), the aged care workforce is essential in the "diffusion of innovation" (ACIITC 2019). There is very little investment made in training, developing and supporting aged care staff in digital literacy (ACIITC 2017, 2019). The Strategy identified the importance of engaging with developments outside of the sector and of reducing barriers to access digital services for both informal and professional carers across the sector (ACIITC 2017).

2.6.1 Improving technology adoption

Issues in the aged care sector have been identified that must change in order for employees to improve their use of new technologies. The first issue is under-developed workforce technological readiness. According to the ACIITC, low levels of digital literacy remain a challenge for the successful implementation of technologies in the sector, and this is especially true of carers with lower literacy skills (Barnett et al. 2017, p. 43; see also Davis, Morgans & Burgess 2016). Regular and supported skills development is necessary to ensure the workforce is technology-literate (Barnett et al. 2017, p. 43). A second issue is that the potential to improve productivity in the workplace is under-developed in the aged care sector. By reducing staff time spent in transit or on administrative tasks, digital technologies have the potential to increase overall productivity in the workforce. Yet there is an unequal distribution of technologies designed to address these issues (ACIITC 2017, p. 48). A third issue is the lack of co-design that includes the workforce to ensure it is appropriate for the sector (ACIITC 2017, p. 33).

To implement changes in the aged care sector, there are specific steps that can be taken. The design and implementation of a national Workforce Technology Development Strategy could support aged care workers to effectively use technologies and incorporate them into organisational systems and processes (ACIITC 2017, p. 48; see also Barnett, Howard & Moretti 2015). Bringing together the aged care workforce, as well as other stakeholders, into a co-design and evaluation process will aid diffusion of these technologies (ACIITC 2017, p. 46).

Information and communication technologies, such as electronic health records, bring significant benefits to the aged care sector by increasing knowledge and clinical support

(ACIITC 2017; Zhang, Yu & Shen 2012, p. 690). The increasing number of studies on electronic health records suggest they offer numerous benefits including, among others, improved data management efficiencies, improved monitoring and quality of care, better decision making, and better communication (Barnett et al. 2019; Zhang, Yu & Shen 2012, pp. 694–700). However, the sharing of electronic health records both within the aged care sector and with the healthcare sector is poorly researched and continues to be inadequate in practice (Barnett et al. 2019). The the role played by aged care staff in the diffusion of innovation in aged care organisations is explored as a key focus in this thesis.

2.7 Paradigms of wellbeing

2.7.1 Defining wellbeing

Wellbeing is defined in order to understand the wellbeing of aged care workers. According to Veenhoven (2012), wellbeing is closely related to the concept of "quality of life", although the two concepts 'suffer from a definitional fragmentation' (Jose et al. 2013, p. 54), with varying definitions. Veenhoven (2000) breaks "quality of life" down into multiple elements, including "subjective appreciation of life", or "subjective wellbeing" (Jose et al. 2013). This includes an individual's internal feelings toward their life and specific parts within their life, such as job satisfaction (Jose et al. 2013).

Needs are also important to the wellbeing of aged care workers. The literature discusses six widely recognised and interrelated dimensions of universal human needs: "biological–material, social–psychological, productive–creative, security, self-actualisation and spiritual". These are derived from social, psychological and human development theory and can be used to understand wellbeing (Fromm 1975; Gil 2012; Maslow 1970).

Individuals are more likely to give up on change or reduce their effort if they have a low self-evaluation (Cole 2006, p. 3). They are also more likely to experience stress and engage in behaviours such as avoidance, turnover, absenteeism and procrastination if they find work insecure or demanding (Cole 2006, p. 3). Research conducted by Vinokur and Schul (1997) also suggested that higher levels of self-control and self-efficacy improved the likelihood of finding new work within six months of losing a job. Employment and health outcomes were also generally improved with higher levels of emotional stability (Cole, Daly & Mak 2009, p. 467).

With considerable research into wellbeing, a number of paradigms exist that frame how wellbeing is understood. These differing paradigms impact how technology development might be conducted to address or improve wellbeing. The key paradigms relevant to wellbeing of aged care employees are the medical model of wellbeing, hedonic psychology and subjective wellbeing. These three paradigms of wellbeing are briefly discussed below.

2.7.2 Medical model of wellbeing

The most pervasive model of wellbeing is the medical model. The model is most commonly associated with the International Classification of Diseases and Diagnostic and Statistical Manual. Huppert and So (2013) reviewed a range of international measures for mental disorders like anxiety or depression and identified two poles to form a scale of mental health, ranging from mental wellness to mental illness. They also identified ten components to wellbeing: "engagement, emotional stability, competence, meaning, positive emotion, optimism, vitality, relationships, self-esteem and resilience".

2.7.3 Hedonic psychology

Beyond strictly medical practice, a model of psychology sees wellness as stemming from positive experiences. Kahneman, Diener and Schwarz (1999) argue that the "hedonic" view of human psychology goes beyond the ancient view of hedonism as a pursuit of physical pleasure and instead recognises the subtle pleasures of achieving life goals. In other words, achieving personal pleasures can go beyond personal satisfaction to have an impact on relationships, communities and even economies (Kahneman, Diener & Schwarz 1999).

Hedonic psychology is already an important part of modern society. It is prevalent in contemporary industrial, digital and architectural design, which all acknowledge the importance of creating a desirable and seamless user experience. Norman (2005) argues that these levels of pleasure are experienced at the visceral, behavioural and reflective levels. Studies, such as by Hassenzahl and Beu (2001), have also sought to show how devices can help develop positive emotions in human–computer interactions.

2.7.4 Subjective wellbeing

Subjective wellbeing places the individual's own perception and experience at the centre of any measure of wellbeing. Although individuals' personal measures of wellbeing can vary

significantly, subjective wellbeing is typically understood along an axis of self-evaluative judgements of one's life through to experienced affect (Lambert et al. 2020, p. 2). Evaluative judgements tend to include factors relating to life satisfaction, such as income and quality of life, while experienced affect reflects psychological needs, including a sense of fulfilment in daily tasks, social relationships and autonomy (Lambert et al. 2020, p. 7). Subjective measures of wellbeing have also been defined as consisting of three components: life events, life satisfaction and a sense of fulfilment (Kahneman, Diener & Schwarz 1999). These measures have been used, for example, to develop national happiness indices (Diener 2000; Diener & Suh 2003), which are increasingly used to inform government policies.

2.8 Job demands that impact the wellbeing of carers

In aged care organisations, one of the central challenges is having access to highly engaged and committed staff who remain active at an organisation long enough to provide a continuity of quality care (Kaine 2012; King et al. 2013). This section discusses the work demands that can impact carer wellbeing.

2.8.1 Providing quality care

The work of carers, while rewarding, is also emotionally and physically draining. Carers are expected to provide services ranging from basic clinical and hygiene care to hospitality, cognitive stimulation and wellbeing activities for those under their care. This breadth of work duties is complicated by the context of aged care, where carers are regularly exposed to stressful, end of life situations involving those they care for including challenging behaviours, chronic and acute ailments, and death. While the mandatory level of certificate training (Certificates III and IV) provides carers with competencies required to deliver work tasks, the broader emotional robustness and energy levels required to stay active and engaged in care work are difficult to acquire in simulated environments (Baldwin et al. 2015).

Care staff who are overburdened with the personal strain associated with the provision of emotionally draining work can quickly become disengaged, reducing their alertness and attention to changes in the health and wellbeing of those under their care. The combined effect of disengagement and staff turnover on resident care can be profound, as continuity and quality of care suffers and the relationship formed between caregiver and recipient becomes transactional and under-developed. With the expected growth in demand, requiring the care

workforce to both renew and grow to three times its current size in the next three decades, staff disengagement and retention pose some of the most visible threats to high quality care in the Australian aged care sector (Baldwin et al. 2015).

Current solutions for these issues have encouraged aged care providers to adopt a more efficiency-driven approach, outsourcing care to temporary agency staff when required, and setting up highly routinised work environments where care staff are required to undertake certain preventative duties at set times (Radford et al. 2015). In many ways, an efficiency and output-driven model of residential aged care has also been encouraged through the Australian government's implementation of the residential aged care quality indicators (ACQIs) in 2016. The ACQIs have three measures: incidents of pressure injuries; sudden, unplanned weight loss; and the use of physical restraints. However, the human resource strategies, management practices, employee work behaviours and quality of care considerations, which may form the antecedents of the positive outcomes quality indicators, are not captured.

2.8.2 Aged care as an industry in transition

The transition of the industry to the consumer-directed care model (Department of Social Services 2012) and the disruption this will cause can burden aged care workers. Davis et al. (2016) recognised that in the Australian context increased demand for autonomy, choice and flexibility, as well as changes to consumer expectations more broadly, have resulted in changes to the models of care and the roles of aged care workers. Davis et al. (2016) also acknowledge that the culture of care is being impacted by person-centred and consumer-directed models of care which can have important effects on staff (Heponiemi et al. 2011).

2.8.3 Industry regulation

The aged care sector is highly regulated, which can lead to a compliance culture with a heavy emphasis on regulations and a fear of litigation (Bauer 2007; Davis et al. 2016; Stokoe et al. 2016). Nurses working in the healthcare sector report that regulation and fear creates a tension between the rights of older patients, the obligations placed on nursing staff by their employers, and their own sense of a duty of care (Bauer 2007; Davis et al. 2016; Stokoe et al. 2016).

2.8.4 Organisational justice

Another factor in the aged care sector found to affect nurse wellbeing and satisfaction is organisational justice, or the sense that employers act fairly toward employees (Rodwell & Martin 2013). Workplace related factors such as commitment and job satisfaction, wellbeing and mental distress have all been associated with organisational justice (Rodwell & Martin 2013; see also Elovainio et al. 2002; Heponiemi et al. 2011; Kivimaki et al. 2002). In the long-term care of aged care residents, issues relating to procedural injustice have been shown to lower productivity and quality of care (Rodwell & Martin 2013; see also Heponiemi et al. 2007; Pekkarinen 2008).

2.8.5 Low wage levels

Wages in the aged care sector are lower than the wages and conditions in other healthcare sectors. An Access Economics (2009) report on residential aged care noted that nurses in this sector are paid 10% less than their counterparts in acute care, though aged care nursing requires complex practice (Davis et al. 2016; Dwyer 2011). This makes it difficult for aged care organisations to maintain suitable skill sets and staff numbers, exacerbating job dissatisfaction caused by high workloads and poor skills and affecting the wellbeing of aged care staff. This is exacerbated by the average pay received by aged care workers not being sufficient as a primary motivation to stay in an organisation (Kaine 2012).

2.8.6 Care demands of residents and their families

As a central element of the aged care sector, working with clients presents complexities for aged care workers. There are a range of aspects of care services that older people associate with their quality of life and wellbeing (Jose et al. 2013). These include continuity of care, punctuality, good communication, flexible services, mutual respect and reciprocity between carers and residents, confidence and professionalism (Furulawa, Kessler et al. 2003; Francis & Netten 2004; Gantert et al. 2008; Graham & Bassett 2006; Jose et al. 2013; Lewinter 2003). These characteristics highlight some of the demands placed on aged care workers.

The literature also shows the burden placed on carers during the transition of older people into an aged care facility. Families can be a source of stress for aged care workers, because the process of moving into aged care can be emotional for families and carers as well as the older

people making the transition (Brownie, Horstmanshorf & Garbutt 2014, p. 1655; Cheek et al. 2007; Ellis 2010).

2.8.7 Relocation stress syndrome

"Relocation stress syndrome is a nursing diagnosis" that recognises negative psychological and physical impacts people experience when transitioning to long-term care (Brownie, Horstmanshof & Garbutt 2014, p. 1655; see also Manion & Rantz 1995). Depression, anger and loneliness are more likely to occur in residents who enter an aged care facility without making the decision to do so themselves (Bland 2005; Brownie, Horstmanshof & Garbutt 2014; Fraher & Coffey 2011; Iwasiw et al. 1996; Johnson et al. 2009; Komatsu et al. 2007; Nay 1995; Wilson 1997). These are difficult issues for carers to deal with and can affect carers' wellbeing.

2.8.8 Unattractive career

The literature clearly shows that the Australian aged care sector continues to be perceived as unattractive and struggles with workforce management problems like shortages of aged care staff and an increasing demand for staff. The literature also suggests that to address these challenges, research into factors that affect recruitment, retention and performance in the sector is critical (Rodwell & Martin 2013; see also Boekhorst et al. 2008; Elliott et al. 2012). Low job satisfaction and the negative impacts that caring work has on the mental wellbeing of aged care workers impact the sector's capacity to attract and maintain a skilled workforce (Edvardsson et al. 2011; Elliott et al. 2012; Pitfield et al. 2011; Rodwell & Martin 2013).

2.9 Wellbeing and technology in the aged care industry

This section explores how technology intersects with the wellbeing of aged care workers. Technology can have significant effects (positive or negative) on wellbeing, including three particular aspects of wellbeing: practical wellbeing, emancipatory wellbeing and technical wellbeing (Mitchell 2011).

Some case studies show that e-therapy enables interventions and care at an earlier stage of mental health issues (Christensen & Hickie 2010; Gaggioli et al. 2014), allowing home-based patients to receive treatment in an environment that is less likely to cause anxiety (Mair & Whitten 2000; Riva, Calvo & Lisetti 2015). Online therapeutic treatments can be used to "reach

people in isolated places" (Hordern et al. 2011; Riva, Calvo & Lisetti 2015) and the online environment enables positive psychology approaches (Gaggioli et al. 2017; Schueller & Parks 2017). These platforms and tools reduce the barriers some people face in finding care, facilitating improved access.

In relation to family carers, Marziali and Donahue (2006) assessed the use of online therapeutic tools (Imamura 2014, p. 16). Caregivers in the intervention group received therapeutic support with online video conferencing sessions, with participants showing a decrease in stress and an increased empathy toward others (Marziali & Donahue 2006). A program run by the Resources for Enhancing Alzheimer's Caregiver Health tested the effectiveness of telephone-linked care between carers and people with dementia. The program measured both the behaviours of the person with dementia, the stress levels of their caregivers, and facilitated communication with a geriatric nurse and other caregivers. The stress felt by caregivers decreased after implementation (Imamura 2014; see also Mahoney 2011; Mahoney et al. 2003).

Another concept that may be potentially applicable for the wellbeing of aged care workers in the context of innovative and disruptive technologies is persuasive technology. According to Fogg (2002, p. 1), persuasive technologies are "interactive computing systems designed to change people's attitudes and behaviours" (see also van Bronswijk 2006). As a merger of persuasive technology and gerontechnology, persuasive gerontechnology could be an essential integration of technology to handle ageing issues in society (van Bronswijk 2006). Persuasive technology was introduced by De Kort and others into the field of gerontechnology (IJsselsteijn et al. 2006), albeit emphasising the role of older persons not only as users but as potential co-designers. This is an example of technology in which the focus is on the elderly patient rather than the carer.

The following two hypotheses are derived from this section of the literature review.

2.9.1 H2: Positive computing has an effect on carer wellbeing

With an expected boom in demand requiring the care workforce to both renew and grow to three times its current size in the next three decades, staff disengagement and retention are some of the most visible threats to the viability of high quality care in the Australian aged care sector (Baldwin et al. 2015). "Current solutions for these issues have encouraged aged care providers to adopt a more efficiency-driven approach, outsourcing care to temporary agency

staff when required, and setting up highly routinised work environments where care staff are required to undertake certain preventative duties at set times" (Radford et al. 2015 p 557).

However, the current efficiency-driven work environment for work of carers can be mentally and physically draining for them, reducing their wellbeing. Positive computing frames wellbeing and strength explicitly as issues within the discourse of digital design. Improvements in wellbeing have been shown to have an influence on employee performance (Truss et al. 2013). The thesis hypothesises that positive computing can play a role in improving or supporting carer wellbeing.

2.9.2 H3: Positive computing is positively associated with proactive care

One of the key approaches in positive computing is to develop processes that have positive effects on the organisation and individual workers (Calvo & Peters 2014). This includes strategies that build workers' wellbeing and require the organisation to assess itself based on the wellbeing of its staff. In aged care organisations, one of the central challenges is having access to highly engaged and committed staff, who remain active at an organisation long enough to provide a continuity of quality care (Kaine 2012; King et al. 2012). The thesis hypothesises that positive computing, by focusing on processes that have a positive effect on aged care organisations, can have an effect on the level of proactive care provided by carers to their aged care residents.

2.10 Perceived organisational support

Increasingly, leaders in modern organisations recognise that in order to maintain a competitive advantage they must attract, cultivate and retain employees with the necessary skills and capabilities in their industries (Aguirre et al. 2009; Clifton 2014; Dychtwald et al. 2013; Mercurio 2015; Pangarkar & Kirkwood 2013). In the contemporary context of continuing globalisation, increased competition, economic uncertainty, ongoing change and the mobile millennial generation, scholars and practitioners have increasingly focused on the drivers of employee commitment (Cohen 2007; Fornes et al. 2008; Gibb 2011; Mercurio 2015; Meyer et al. 2002; Morrow 2011).

Perceived organisational support is the degree to which employees think that their organisation values their contributions and "how much the organisation cares about the employees'

wellbeing" (Eisenberger et al. 1986). Expanding on their research, Eisenberger and colleagues proposed that employees of organisations develop generalised beliefs about how far organisations will go to support their employees (Eisenberger et al. 1990; Eisenberger, Huntington et al. 1986).

The research outlined in this section suggests that affective commitment may have a greater impact on workplace behaviours, such as tenure and turnover, than other theories of organisational commitment do. The research also suggests that affective commitment is an essential element of organisational commitment more broadly. These findings inform hypothesis 1 below.

2.10.1 H1: Perceived organisational support is positively associated with positive computing

Positive computing was defined by Calvo and Peters (2014, p. 2) as the "design and development of technologies to support wellbeing and human potential". Positive computing is informed by positive psychology, which is strengths-based and promotes wellbeing and flourishing rather than focusing on deficits (Seligman & Csikszentmihalyi 2000). Perceived organisational support is the degree to which employees think that their organisation values their contributions and how much the organisation cares about the employees' wellbeing (Eisenberger et al. 1986). The perceptions of employees of the degree of involvement they have with their organisation's practices impact their levels of affective commitment (Allen & Shanock 2013; Eisenberger, Fasolo & Davis-LaMastro 1990; Kinnie, Hutchinson, Purcell, Rayton & Swart 2005; Mercurio 2015; Rhoades, Eisenberger & Armeli 2001; Whitener 2001). Perceived organisational support and trust emerge from the literature as important variables that impact positive perceptions of practices within an organisation (Mercurio 2015). This thesis hypothesises that positive computing can be an enabler for perceived organisational support.

2.11 Research gaps and forming the hypotheses

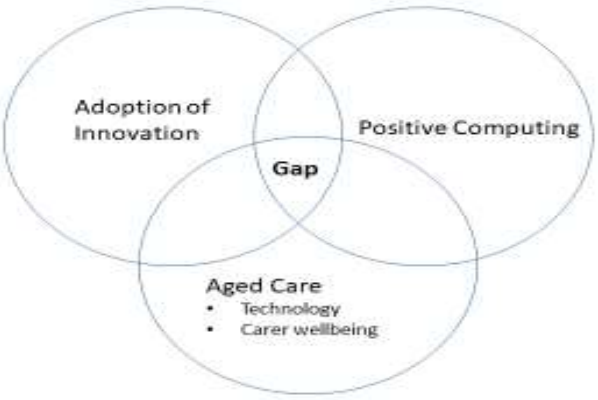
This chapter has reviewed the existing literature on wellbeing and technology in the aged care sector and draws six conclusions:

1. The aged care industry has many challenges that need to be addressed to make the industry sustainable, particularly related to attracting and retaining its workforce. Aged care workers have a demanding and difficult job that can negatively affect their wellbeing.
2. Positive computing is a relatively recent development and there is very limited research in the field.
3. There is no research on the manifestation of positive computing in the aged care industry and on aged care workforce outcomes.
4. The aged care industry has been slow to innovate and adopt technology to address its challenges including workforce issues.
5. Innovation and technology are critical to ensuring the sustainability of the aged care industry.
6. A technology literate aged care work force is vital to the future sustainability of the industry and the aged care workforce is considered critical to the adoption and diffusion of technology in aged care organisations.

This thesis seeks to address a specific gap in current research located in the overlap of adoption of innovation theory and positive computing and the wellbeing of aged care workers in the context of Australian aged care organisations.

The research gap is presented in the Venn diagram in Figure 2.2.

Figure 2.2 Venn diagram of the research gap



This thesis primarily responds to the call from Pawlowski et al. (2015) to extend research into positive computing by contributing an explanatory study by proposing and testing a new instrument to measure the impact of positive computing on the wellbeing of aged care staff. This study also hopes to contribute to the core research question of Pawlowski et al. (2015, p.

407): “How is it possible to create technology-induced changes which improve the employees’ situation and are perceived as positive?”.

Secondly, the thesis responds to the findings from the Aged Care Technology Benchmark Survey which suggest that, in terms of providing care, the aged care sector had a low level of technological readiness (Bartnett et al. 2017, p. 41). In reviewing the aged care sector, the ACIITC (Bartlett et al. 2019) made a number of value statements to guide the implementation of new technologies in the aged care sector. First, co-design is essential when developing technologies for the provision of care, wellbeing and support. Second, co-evaluation with end users is necessary when measuring the effectiveness of these technologies (ACIITC 2017, p. 47).

The following four hypotheses were developed from the research questions and were tested during the quantitative and qualitative research phases:

H1: Perceived organisational support is positively associated with positive computing.

H2: Positive computing has an effect on carer wellbeing.

H3: Positive computing is positively associated with carers’ proactive care.

H4: Positive computing is positively associated with carers’ affective commitment.

The following chapter presents the research methodology to test the hypotheses.

Chapter 3: Methodology and Research Design

3.1 Overview

A key goal of academic research within a specific field of study is to search for and explore answers to theoretical questions (Rubin 1983). According to Sapsford and Jupp (2006), methodologies in research are specific worldviews or philosophical standpoints that inform how research is conducted (Sapsford & Jupp 2006). Research methodology is, according to Creswell (2009), the strategy taken in all aspects of the design process of conducting research, including collecting and analysing data and determining its theoretical basis. When adopting a method for a research design, two major factors must be considered: the research topic and the research question (Saunders et al. 2009; Yin 2009). After reviewing various research paradigms to evaluate which were best suited to this research, the pragmatic paradigm was considered the best fit for this study, as it supports a mixed methods research design. In this thesis, the mixed methods research design consisted of a two-phase explanatory sequential study: the first phase was a quantitative study and the second was a qualitative supportive study. The data collected during both phases and the literature review were used to answer the research questions. There are five research questions:

1. How does positive computing manifest in the context of aged care work?
2. To what extent does positive computing affect the work outcomes of aged carer staff?
3. To what extent does positive computing affect employee wellbeing?
4. To what extent does positive computing affect the provision of care?
5. How can positive computing promote diffusion of innovation in aged care organisations?

This chapter outlines the steps involved in developing the research design for this study and the guiding philosophy. Section 3.2 discusses the research design for pragmatism, Section 3.3 discusses the mixed methods approach, Section 3.4 discusses the quantitative phase, Section 3.5 discusses the qualitative phase and Section 3.6 presents the ethics approval. Section 3.7 concludes this chapter.

3.2 Research paradigm: Overview of pragmatism

The pragmatism paradigm has been selected as the most suitable for this study. Research paradigms are perceptions, beliefs and philosophical positions about reality (Morgan 2007). This has been described as a worldview, which includes the researcher's perspective, beliefs, how they look at the world, and their school of thought (Guba & Lincoln 1994; Lather 1986; Mackenzie & Knipe 2006). The research paradigm determines how a researcher designs their research methodology and how they analyse their data. It is therefore essential to identify the paradigms used in the development of the research methodology, which in this case is pragmatism.

Pragmatism as a research paradigm can be traced to the period from 1860 to 1930 while the neo-pragmatic era is from 1960 to the present (Maxcy 2003). Creswell and Plano Clark (2007) argue that pragmatism is the most appropriate worldview for mixed methods research, as its focus on workability allows an approach to research that includes both qualitative and quantitative analysis. The pragmatist worldview acknowledges the importance of multiple perspectives because 'there may be multiple realities' (Saunders et al. 2012, p. 144). The pragmatism paradigm, according to Creswell and Plano Clark (2007, p. 41), uses diverse approaches, "draws on many ideas, including what works", and makes use of both subjective and objective knowledge.

Pragmatism considers the practice of choosing one positional paradigm as unrealistic. Instead, it argues that the most important factor determining which position to adopt is the research question (Creswell & Plano Clark 2011; Saunders et al. 2009). This is especially relevant when it is not immediately clear whether an interpretive or positivist outlook should be applied to a particular research question. According to Dudovisky (2018), pragmatism can integrate more than one research approach and strategy into the same study, such as a combination of qualitative, quantitative and action research methods. However, it is sometimes necessary for researchers to adjust 'their philosophical assumptions over time and move to a new position on the continuum' (Collins & Hussey 2014, p. 54). The pragmatism paradigm encourages mixed methods approaches to research and to draw comparisons between methods. Mixed methods research is supported by Johnson and Onwuegbuzie (2004, p. 14), who argue that its "methodological pluralism or eclectism" often yields better results than single method research.

The pragmatic approach is supportive of research where a theoretical basis remains under-developed. Research into the manifestation of positive computing is in its infancy and does not exist within an aged care context. With these factors in mind, pragmatism was considered to be appropriate for this research.

3.3 Mixed methods research

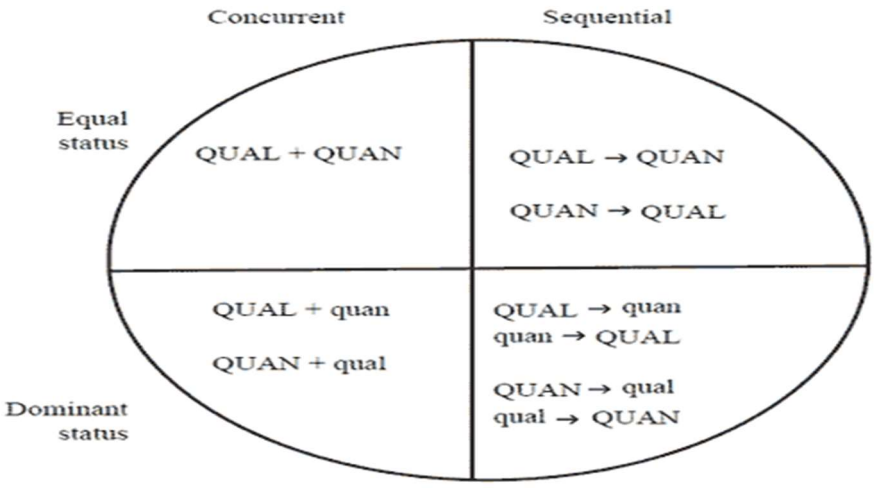
Mixed methods research focuses on the processes and outcomes of quantitative and qualitative methods and how the data is collected and analysed (Creswell & Tashakkori 2007). According to Creswell (2009), a key objective of mixed methods research is to make the research outcomes more objective by neutralising any biases associated with a one method design. The perspective that a mixed methods research design is preferred to a one method design is supported by Johnson and Ongwuegbuzie (2004, p. 14), who argue that a mixed methods design produces superior research. Creswell and Plano Clark (2007, p. 5) recommend adopting a mixed methods research design when the study requires the collation and detailed analysis of both qualitative and quantitative data. According to Creswell (2009), combining qualitative and quantitative methods achieves better insights than using one without the other. The increasing complexity of fields of study and research questions, a desire for deep and broad analysis, and the increasing linkages between research and policy development have all led to the increasing prevalence of mixed methods research. Mixed methods research is therefore suited to this study as aged care, positive computing and technology are very wide and complex fields of study further complicated by the number of stakeholders involved.

Mixed methods, which emerged in the 1980s, seeks to unify the quantitative methodological movements (Tashakkori & Teddlie 2003, p. 697). Several researchers and theorists have emerged as authorities in mixed methods research, including Mertens (2005), Creswell (2003), Tashakkori and Teddlie (2003), Mingers and Gill (1997) and Greene and Caracelli (1997). Johnson and Onwuegbuzie describe mixed methods research as a “useful middle position” (2004, p. 17) that seeks to find practical, outcome-focused approaches to study. Combining statistics with thematic approaches mitigates any dependence on statistics with subjective factors and “soft-core views and experiences” (Jogulu & Pansiri 2011). Since a mixed methods approach combines paradigms, it facilitates the use of inductive and deductive forms of reasoning, allowing researchers to generate theories and test hypotheses within a single research project (Jogulu & Pansiri 2011). An additional benefit from a mixed methods

approach includes an opportunity for early career researchers to develop skills across methodologies. It has also become increasingly popular as a method in multidisciplinary studies, particularly in substantive fields like disability, childhood and complex social issues, and for research in complex and pluralistic contexts, such as schools. Aged care and technology as a research field shares these characteristics with childhood and disability research.

Johnson and Onwuegbuzie (2004) outline a number of mixed methods design typologies. The most common design approaches are concurrent and sequential. In concurrent design, a single study incorporates multiple research methods at the same time. In a sequential design, one method is used first, followed by the other. The matrix in Figure 3.1 below, developed by Jogulu and Pansiri (2011), demonstrates these typologies.

Figure 3.1 Different approaches to mixed methods design



Notes: "Qual" stands for qualitative; "quan" stands for quantitative; " + " stands for concurrent; " → " stands for sequential; capital letters – "QUAL" and "QUAN" denote high priority or weight; lower case letters – "qual" and "quan" denote lower priority or weight

Sources: Adapted from Creswell (2003); Johnson and Onwuegbuzie (2004); Tashakkori and Teddlie (1998); Pansiri (2005, p. 202)

Figure 3.1 identifies the different approaches to a mixed methods design. Jogulu and Pansiri developed it while analysing two management doctoral theses that used mixed methods research (2011, p. 691), both using a sequential approach with a quantitative phase then a qualitative phase. The same sequence with an initial quantitative study and then a subsequent qualitative study is used in the mixed methods design in this thesis research.

3.3.1 Mixed methods: Rationale for use in this research

The design of the mixed methods in this research relied on relevant literature. Two of the five rationales for mixed methods research identified by Greene et al. (2005) are relevant to this research: complementarity and initiation. The initiation rationale applies when new research questions arise from new insights. Complementarity applies when the results from one method are used to improve, explore or clarify those from another. As the manifestation of positive computing in an aged care context is a new field of study, both rationales of complementarity and initiation meet the objectives of this study. This research uses a measurement instrument that has been developed for the context of this research, and so a complementary study is necessary to clarify and explain the results. This research also seeks to initiate further research from the insights gained from this study, and so an initiation rationale also applies.

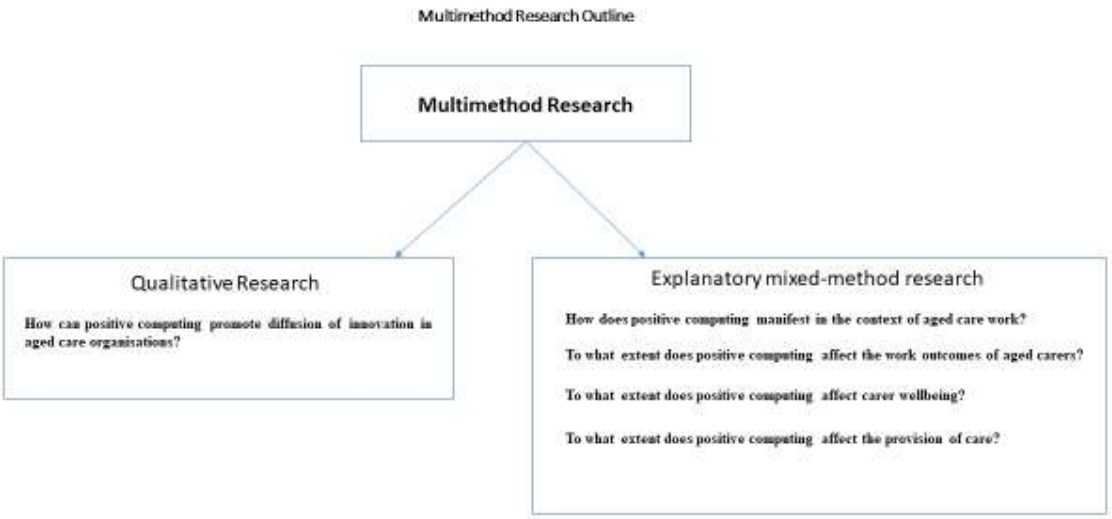
As there is currently very little research on the manifestation of positive computing in the aged care context, it is essential for this research that the findings are carefully considered, are valid and have integrity. Therefore, the explanatory design with mixed methods used in this research is appropriate where little comparative research is available. A sequential model was considered necessary for this study because its focus is in a new research area, and because a sequential approach allows the quantitative results to help identify key themes, which can be explored further during qualitative interviews.

There has been an increase in mixed methods research in the healthcare sector which has corresponded with the increasing complexity of healthcare delivery (Shorten & Smith 2017, p. 74). In a context in which policymakers and healthcare providers seek to ensure the safety of patients and the quality of care, mixed methods research allows researchers to explore complex questions and diverse perspectives, and develop ‘a more panoramic view of their research landscape’ (Shorten & Smith 2017, p. 74). Factors in healthcare research are very relevant to aged care research, contributing to the rationale to use a mixed methods approach in this study.

3.3.2 Multi-Method Design

The overall design of this study is a multimethod design composed of one qualitative research and one explanatory mixed-method study, as shown below.

Figure 3.2 Schematic overview for the multimethod research outline



Where research utlises two or more types of quantitative or qualitative data, it is classified as multimethod research (Creswell 2015). This approach to research seeks to "address complex social questions" (Greene 2015) by gathering and analysing data of various types and using the findings to "meaningfully engage with difference" (Greene 2015, p. 607). Onwuegbuzie and Leech (2005) argue that four key reasons support the use of multimethodology: "a broad view on an issue provides a more holistic perspective; different types of research will have strengths and weaknesses depending on the type of research being conducted, and therefore using multiple methods will better supplement an understanding of complex issues that span multiple research areas"; much research already relies on multiple methodologies, but this is frequently unaccounted for; and "multimethodology works well with a pragmatic approach to research" (Onwuegbuzie and Leech ,2005).

As outlined by Anguera et al. (2018), multimethods research "does not only allow a researcher to answer various questions but also allows them to discover new questions through their analysis". It also requires: "multiple constructs; multiple measures of each construct; and multiple populations of persons, settings, and times"(Anguera et al. 2018, p. 34). Anguera et al. (2018) identify that there is a "confusion between multimethods and mixed methods approaches that is not only related to terminology", but also "methodological orientation, driven by personal preferences or field of research" (Anguera et al. 2018, p.34). One important difference is that multimethods research does not demand integration (Plano Clark & Ivankova

2016). This is because “multimethods employs multiple methodologies to answer multiple research questions and achieve various goals”, rather than “pursuing one question or goal”. In short, mixed methods research requires “combining or integrating the methods through analysis, whereas multimethods has no such requirement” (Anguera et al. 2018). Rather than being restricted to combining quantitative and qualitative methods, “it is open to a broader variety of methodological combinations” (Hunter & Brewer 2015, p. 187).

The qualitative phase focussed on research questions number four: How can positive computing promote diffusion of innovation in aged care organisations?

Table 3.1 Research Question Data Source

Research Question	Data Sources
How can positive computing promote diffusion of innovation in aged care organisations?	Qualitative Interviews

This approach was taken as innovation is not part of the positive computing paradigm, so questions were asked during the interviews with two care staff on innovation.

3.3.3 Explanatory mixed methods design for this study

3.3.3.1 Mixed methods design and the research questions

Research questions and hypotheses are essential in determining appropriate research methodologies. Quantitative methods, for example, are useful in answering questions related to frequency, while qualitative methods are effective at exploring issues of perception and opinion. A mixed methods research design is appropriate when the research questions and hypotheses require quantitative and qualitative data. After a large survey, “mixed methods are also often used to explore a specific cohort of the population in more detail” (Creswell 2009). The research questions in this study measure positive computing constructs and so quantitative analysis is appropriate. This approach is necessary due to the lack of quantitative research investigating the manifestations of positive computing in an aged care context. Table 3.1 summarises the research questions and data sources and Table 3.2 summarises the hypotheses and their data sources.

Table 3.2 Research questions and their data sources

Research Question	Data Sources
How does positive computing manifest in the context of aged care work?	Quantitative Questionnaire & Interviews
To what extent does positive computing affect the work outcomes of aged carers?	Quantitative Questionnaire & Interviews
To what extent does positive computing affect carer wellbeing?	Quantitative Questionnaire & Interviews
To what extent does positive computing affect the provision of care?	Quantitative Questionnaire & Interviews

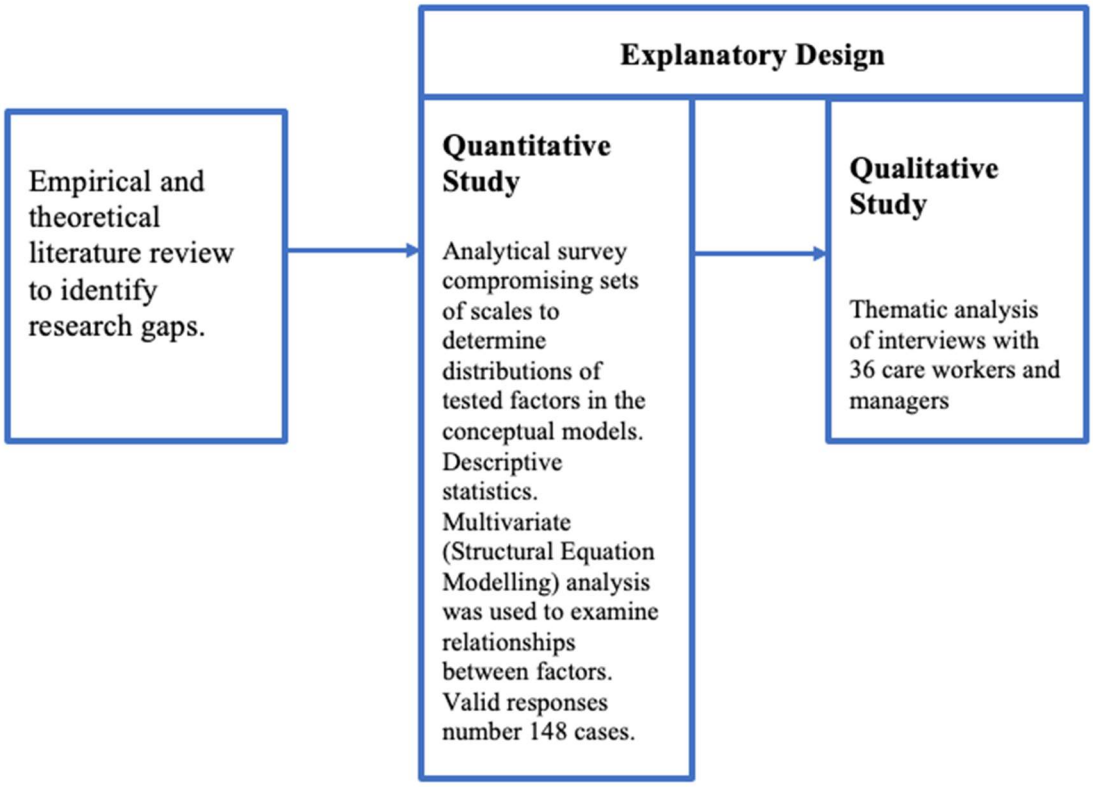
The hypotheses are tested from the data sources as outlined in Table 3.3.

Table 3.3 Hypotheses and their data sources

No.	Hypothesis	Data Sources
H1	Perceived organisational support is positively associated with positive computing.	Quantitative Questionnaire & Interviews
H2	Positive computing has an effect on carer wellbeing.	Quantitative Questionnaire & Interviews
H3	Positive computing is positively associated with carers' proactive care.	Quantitative Questionnaire & Interviews
H4	Positive computing is positively associated with carers' affective commitment.	Quantitative Questionnaire & Interviews

Figure 3.3 presents an overview of the sequential mixed methods design for this study.

Figure 3.3 Schematic overview for the explanatory sequential mixed methods design



The explanatory design process was used to answer the research questions. The research questions are answered using the literature review, as well as analysis of the results of both the quantitative and qualitative phases of research. The research questions are suitable for quantitative analysis as they focus on measuring positive computing and aged care worker wellbeing and examine causality between them. The study is explanatory because the qualitative data is used to investigate in more detail the results derived from the quantitative analysis and the study significantly benefits from the supplementary qualitative component.

Extensive research literature highlights the ways "quantitative and qualitative research can be integrated to improve insights into complex phenomena" (Bernard 2013; Meert et al. 2012; Elliott 2005; Polit & Beck 2008). However, no definitive examples of how to use mixed methods research in the combined fields of positive computing, innovation and aged care currently exist. After a detailed assessment of the quantitative and qualitative research in aged care, innovation and the little research available in positive computing on mixed methods, it was clear that a compromise was necessary in the amount of quantitatively and qualitatively-oriented research that could be completed within the time constraints and sample limitations of this study. It was determined that the quantitative phase would be strengthened if the

instrument's measurement had fewer items, as a shorter survey would likely reduce missing data and increase overall response rates (Meert et al. 2012). For the qualitative phase, it was important to have an opportunity to develop a detailed understanding of the patterns revealed by the new instrument's testing results. Meert et al. (2012) used a similar strategy in the design of an instrument they used with bereaved parents.

3.4 Research design: Quantitative study

The first phase of this research was a quantitative study. The quantitative study in this thesis used a self-reporting structured questionnaire instrument to measure the manifestation of positive computing in the aged care workforce. Normal distribution of the data was determined by testing the data. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), as well as structural equation modelling analysis, were used to refine the original scales.

According to McMurray et al. (2004), quantitative analysis is the use of statistical reasoning to identify patterns and relationships in numeric data. Quantitative research, such as questionnaires or surveys using Likert scales together with sociodemographic data, collects data in a numerical form, "which is then categorised or measured to allow researchers to develop observations and identify patterns to test a theory or hypothesis" (Macleod 2017).

Quantitative research is the mathematical analysis and use of numerical data to explain phenomena (Aliaga & Gunderson 2000, p. 23). Statistics used in this research are descriptive and inferential. Quantitative research and analysis aims for objectivity (i.e., the elimination of bias); it is separate from the data and the design. This research phase needs to be determined before it begins (Macleod 2017). Hypotheses can be tested using statistical analysis (Antonius 2012; Macleod 2017). As such, the quantitative approach is considered scientifically objective (Carr 1994; Denscombe 2010; Macleod 2017). The integrity of quantitative analysis can be managed by applying the parameters of robust quantitative analysis.

There are a number of techniques used in quantitative analysis to ensure the robustness of the findings, and they are discussed in this section. When a theoretical construct is represented by valid factors, multivariate analysis can evaluate the probability of a relationship with other constructs as being significant (Ping 2004). Statistical significance testing is used to determine the probability that multiple factors may be related due to chance (Neuman 2003). As well as the validity and reliability of a construct, other conditions must be satisfied to observe

statistically significant relationships, including the distribution of each factor, the sample size, controlling factors, such as context variables, and the contextualising premise or proposition of a theory between two or more factors. The central tendency of a variable has two important measures: standard deviation (SD) (Kalleberg et al. 1990) and the mean score (Neuman 2003). Kurtosis "measures the degree to which scores cluster in the tails of a frequency distribution" (Field 2013, p. 878) while skewness relates to "the symmetry of a frequency distribution" (Field 2013, p. 884). Analysing parametric data with statistical reasoning "requires it remains close to a normal distribution and not skewed" (McMurray et al. 2004, p. 132). This quantitative study used normality testing for the measures and the results from the normality testing are provided in Chapter 4.

According to Neuman (2003, p. 362), during statistical analysis 'alternative explanations' must be controlled for when analysing the relationship between multiple constructs in order for their relationship to be accurately determined. Control variables allow quantitative research to explore the relationships between tested constructs (Becker 2005). There must be theoretically based reasoning for a statistical relationship between multiple factors in order for it to be considered valid. Correlations between unrelated factors can occur randomly in nature and so, to support an analysis that shows a significant relationship between multiple factors is true, rather than random, theory should inform hypothetical relationships between the variables (Hair et al. 2010). The integrity of quantitative analysis can be managed by applying the techniques and the parameters of robust quantitative analysis.

3.4.1 Sampling frame for the study

The structured questionnaire instrument in the quantitative study was made available to 204 aged care staff at the aged care organisation, a not-for-profit residential aged care company with 11 facilities across Western Australia, with most concentrated in Perth. The management of the aged care organisation invited the researcher to provide the questionnaire to staff who were willing to volunteer their time. All facilities and staff of the aged care organisation were asked if they were willing to participate in the research by completing the questionnaire. The purpose of the study was explained and information about confidentiality and ethics approval was provided from the UTS Human Research Ethics Committee (see Section 3.6). Questionnaires were distributed face-to-face on site in aged care facilities, usually in a staff room or lunchroom, during the course of a day between 10 am and 9 pm. The 148 staff who

participated were from a number of the city-based and regional residential facilities of the aged care organisation.

Most research studies have challenges in recruiting participants. Achieving a good response rate is a common issue when conducting surveys (Briller et al. 2008), and it is exacerbated when the target cohort are aged carers in their workplace. Aged carer work is demanding and, while they are working, aged carers are focused on providing care to residents who often have complex needs. Work breaks are also often well defined, due to the complex and timely needs of residents. To achieve a good response rate, this research used a number of strategies including clear instructions on the questionnaire, and item and response formats that could be easily understood to maximise the participation rate of the care staff and to minimise the time taken to complete the questionnaire while staff were on rest breaks. Personalised face-to-face appeals were made to staff to explain the intention and benefit of the research. Staff did not receive any monetary rewards for participating in the research.

The questionnaire was administered primarily in the lunchrooms or staff rooms of the care facilities. Staff had been informed the survey was taking place and were given permission to take time out of their work to participate, however participation was not mandatory. As part of the process of getting permission for participants to complete the questionnaire, this researcher explained the purpose of the questionnaire to participants and assured them of the ethics approval and confidentiality of participation. A total of 148 staff out of a possible 204 (72.5%) participated in the study by returning a completed questionnaire. The number of respondents was limited by constraints on the availability of paid carers and the voluntary nature of the questionnaire. Some paid carers were on leave and others were unavailable, as they were busy caring for residents or were rostered off (the roster had three shifts per day).

A descriptive analysis was performed on the sample of respondents by calculating the frequency and percentage for each demographic characteristic. Demographic characteristics are summarised in Table 3.4 below.

Table 3.4 Descriptive statistics for demographic characteristics

Variable		Frequency	Percent
Gender	Female	109	83.8
	Male	20	15.4
Age	19–29 years old	25	19.2
	30–39 years old	29	22.3
	40–49 years old	42	32.3

	50–59 years old	26	20.0
	above 60 years old	8	6.2
Position	Residential Aged Carer / Personal Carer / AIN	89	68.5
	Other	39	30.0
Highest education	High School	4	3.1
	Certificate III	51	39.2
	Certificate IV	20	15.4
	Bachelor degree	36	27.7
Length of employment	Less than 6 months	9	6.9
	6 months to 2 years	33	25.4
	2 to 5 years	44	33.8
	5 to 10 years	28	21.5
	More than 10 years	16	12.3
Employment type	Full-time	36	27.7
	Part-time	77	59.2
	Casual	16	12.3
English as first language	Yes	74	56.9
	No	56	43.1
Immigrant	Yes	71	54.6
	No	58	44.6
Total		148	100

The majority of respondents (84%) were female, and over half (52%) were aged 40–59 years. The majority of respondents (70%) identified themselves as a residential aged carer/personal carer, and most respondents had post-school education, either through university or TAFE, with only 4% having high school as their highest level of education. The majority of respondents had been employed by the aged care organisation for less than five years and the majority of respondents were employed part-time. Over half of the respondents (57%) said English was their first language, and over half (55%) of all respondents identified themselves as a migrant, defined as being born overseas.

3.4.1.1 Sample size: Representation and accuracy

The sample size used in quantitative research should aim to be representative of the population because sample size can significantly impact whether results can be generalised to the population as a whole (Neuman 2003). One approach to sampling is convenience sampling, which takes samples from a context convenient to the research (Neuman 2003). The applicability of original findings to the population that is being sampled can be assessed in this way (McMurray et al. 2004). Convenience sampling may be used where a total population list cannot be developed (Kalleberg et al. 1990). This was the case with this research as it was not possible to contact all residential carers in the country.

In 2016, the residential and community sectors in Australia employed more than 366,000 aged care workers, which included 240,000 workers in direct care (Mavromaras et al. 2017), although these figures are complicated by the different roles required in the aged care industry. The potential sample population for this study was 204 care workers at the aged care organisation. In this study, the total sample size was 148 completed questionnaires. The sample was drawn from one aged care organisation across multiple sites.

3.4.1.2 Sample size: Precision, detail and accuracy of analysis

The accuracy of factor analysis and the representativeness of results in quantitative analysis may be affected by the sample of respondents. Generally, when testing the relationship between constructs, the sample should neither be too small nor too large (Hinkin 1998), as size can affect type one or type two errors (Neuman 2003). Small samples may cause a type one error and have a disproportionate distribution of one factor. When sample sizes are above 500, the relatedness between factors increases (Hair et al. 2010).

A number of recommendations on sample size have been made. After a review of factor analysis approaches, Field (2013) suggests that stable factor solutions should aim for at least 300 samples. Hinkin (1998, p. 110) recommends that the item-to-response ratios used in factor analysis should be in the order of 1:4 to 1:10. In this study the factor analysis sample size was 148 and the item-to-response ratio was 148 to 204, which is approximately 73% or 3:4. In the structural equation modelling analysis the sample of 148 is acceptable, however a larger sample would have been preferable as the sample size was not close to 300, Field's suggested threshold. The second phase qualitative study explored the quantitative findings.

3.4.1.3 Control variables

In order for statistical analysis to accurately identify a relationship between multiple constructs, 'alternative explanations' and their potential effects must be identified and controlled for (Neuman 2003, p. 362). Control variables allow quantitative research to explore the relationships between tested constructs (Becker 2005). During analysis in this thesis, the control variable of age was used, shown in Table 3.5.

Table 3.5 Age as control variable

Variable		Frequency	Percent
Age	19–29 years old	25	19.2
	30–39 years old	29	22.3
	40–49 years old	42	32.3
	50–59 years old	26	20.0
	above 60 years old	8	6.2
Total		148	100%

3.4.2 Theoretical relationship

Statistical relationships between multiple factors are considered valid when there is a theoretical basis to the reason for the relationship. Correlations between unrelated factors can occur randomly in nature and so, to support an analysis that shows a significant relationship between multiple factors is true, rather than random, theory must underpin a hypothetical relationship between the variables (Hair et al. 2010). The previous chapter provided a theoretical basis to the constructs – positive computing, wellbeing, perceived organisational support, affective commitment and proactive care – and the relationships present between them. This theoretical outline supports the quantitative analysis of the study.

3.4.3 Method of analysis

This research conducted quantitative analysis of responses of a self-reporting questionnaire with psychometric questions to assess the impact of positive computing on the wellbeing of care staff in an aged care organisation. Survey questions were developed using Hinkin's (1998) development framework for questionnaire measurement. Data was collected and tested to confirm that items were distributed normally (see Chapter 4 for normality testing).

This study used EFA and CFA to refine the scales. Both structural equation modelling and EFA are useful statistical techniques for this research, given the explanatory nature of the research. The scales were then subjected to structural equation modelling analysis. The survey data was analysed using structural equation modelling to identify patterns and correlations in the levels of wellbeing of aged care employees and their work outcomes in relation to the effect of positive computing and innovation.

Factor analysis summarises data to more easily establish and interpret relationships and patterns (Yong & Pearce 2013). It is used to sort variables into clusters based on covariance to isolate constructs and concepts (Yong & Pearce 2013). Mathematical procedures are used in factor analysis to identify patterns in a set of variables and simplify interrelated measures (Child 2006).

To assess hypothetical relationships between variables, structural equation modelling was used and is considered a rigorous method (McMurray et al. 2004). Structural equation modelling is an advanced model of multivariable analysis. It combines confirmatory factor and regression analysis, enables simultaneous measurement of relationships between constructs and indicates how well the significance and strength of paths are shown (McMurray et al. 2004). During a structural equation modelling analysis, the strength and significance of hypothetical paths between variables, which represent theoretical relationships between the variables, are analysed simultaneously (McMurray et al. 2004). Indirect effects triggered by variable and mediator combinations are also identified by this type of analysis (Hair et al. 2010).

3.4.4 Measurement development framework

According to Hinkin (1998), it can be complex to build a valid and effective psychometric scale to identify abstract constructs present within a sample. Hinkin suggests reducing the complexity of scale development, where possible, by using pre-existing scales for developing questionnaires, as they have already been tested and undergone a validation process. However, due to the paucity of behavioural quantitative research on positive computing and the aged care industry, the literature review yielded limited suitable quantitative scales on the constructs being researched. Noting Hinkin's (1998) warning about the risk of developing a scale from scratch, a search of the literature resulted in a number of scales used in nursing to measure aspects of wellbeing and positive computing, from which psychometric scales were developed corresponding to the constructs analysed in this research.

A search of the literature on the fundamentals of instrument development, including addressing any conceptual and design issues (Bernard 2006; Dillman 2007; Polit & Beck 2008), was used as guidance in developing the survey instrument. Essential considerations in designing an instrument include identifying if other instruments already exist, determining the specific data that needs to be collated, determining the appropriate reliability and validity assessments,

creating pre-testing protocols, developing the format and content of a new instrument, and evaluating the pilot data.

To undertake valid and robust statistical analysis and develop psychometric constructs, this research used Hinkin's (1998) questionnaire measurement development framework. This section explains Hinkin's (1998) framework and how it applies to this research. Hinkin's framework has six steps: item generation, administration of the questionnaire, EFA, CFA, testing discriminant or convergent validity, and replication.

Instrument development in this research commenced with a review and comparison of instruments that already exist to assess positive computing, wellbeing of aged care staff, diffusion of innovation in aged care and psychometric scales for the workplace. The positive computing literature revealed calls for an instrument to be developed (Pawlowski et al. 2015) but no actual scales were available. Pre-existing survey instruments about aged care staff and wellbeing did not cover carers' views on positive computing and their wellbeing. No instruments that sufficiently measured the manifestation of positive computing in an aged care context were found. This confirmed that the development of a new instrument was necessary to execute the research data collection strategy of this study. This was a concern as, during previous studies where an instrument was developed from scratch (see, for example, Meert et al. 2012, Briller 2008), researchers influenced measurement through the structure, content and process of the new tool. This was a risk that needed to be managed during the instrument development phase.

According to Meert et al. (2012), one of the key factors determining the sequential explanatory design of their research was how to use the qualitative sensibilities that are essential in the wellbeing domain while also contributing quantitative findings to an area in which so little research has been previously conducted. While their research was focused on bereavement, their principles and characteristics are relevant to this research given the paucity of research on the manifestation of care in an aged care context. While it was essential to adapt a quantitative instrument to assess the impacts of positive computing in an aged care context, the inclusion of a qualitative phase allowed this research to complement quantitative data with the subjective experience of workers' wellbeing.

Hinkin (1998) notes that a considerable review of the relevant research should inform the design of the psychometric scales. A hybrid scale was developed based on scales developed in a nursing care context, which was the closest available to aged care staff in the literature. Seven

items related to technology at work were selected: Autonomy (Asakura et al. 2016), Meaning (Yen et al. 2011), Compassion (Rafnsdottir & Gudmundsdottir 2004), Relatedness (Caprara et al. 2012), Empathy (Castilho et al. 2015), Competence (Akamine et al. 2013) and Engagement (Rafnsdottir & Gudmundsdottir 2004). Psychometric constructs from an aged care survey instrument from Farr-Wharton and Shearman (2017) were incorporated into the survey. The items were chosen for the survey on the basis of having being used in a previous survey intrument and having been proven and validated (Farr-Wharton & Shearman 2017). These were for the following: Perceived organisational support, Manager support, Well-being, Affective commitment, Resilience, Optimism, Engagement, Resource adequacy; Managerialism; Affective commitment, Safety participation, Proactive care, and Stress. A review of items was conducted in consultation with my supervisors in order to determine those that were most relevant for the aims of this research to ensure content validity.

In reviewing the items my supervisor and I were guided by relevant papers from the literature, such as "content validity" (Mastaglia et al. 2003), which is considered "a property of the interpretation of an instrument, rather than of the instrument itself" (Mastaglia et al. 2003) . It is, therefore, considered a 'matter of judgement' by (Solans-Domenech et al. 2019, p.253), and other authors such Cannell, Miller, and Oksenberg (1981), and Krosnick and Presser (2015), who discussed "the behaviour of respondents in terms of how they complete a survey".

In developing the instruments the literature was also reviwed for risks involved in self reporting in particular satisficing. Krosnick (1991) suggests that "three factors can determine the chances that satisficing will occur: first the difficulty of the task; second the ability of the respondent, and last their motivation". To manage this risk Krosnick 1991 "proposes reducing the difficulty and improving the motivation, satisficing can be reduced, and the accuracy of self-reports can be improved" (Krosnick 1991). The "two factors thought to encourage satisficing—low ability and motivation of the respondent—are relevant in the selection of middle alternatives" (O'Muircheartaigh et al. 1999). To address this risk of over-reliance on middle alternatives, it is suggested by O'Muircheartaight et al (1999) "adding midpoints to rating scales increases the validity and reliability of results" (O'Muircheartaigh et al. 1999). Also structural equation modelling of error structures from the body of research shows that instruments that do not have middle alternatives increased the likelihood of respondents selecting scale points closest to a midpoint at random. Hence a likert scale with six points was used in the survey instrument for this research.

The literature was also reviewed for guidance on how to develop new survey instruments in a care context (Mbuagbaw et al. 2014; Patrick et al. 2011; Walliullah et al. 2015). The structured questionnaire instrument contains the components of the wellbeing determinants to produce a positive computing scale with wellbeing determinant constructs and enabled an explanatory analysis of the role of positive computing in the wellbeing of aged care workers. The application of Hinkin's (1998) framework to the positive computing constructs is discussed in Chapter 4, which presents the quantitative analysis findings. Table 3.6 shows the source literature on which the questions were based. The survey instrument and factor leadings from the use of the survey items can be found in Appendix 1.

Due to the time constraints of aged care workers it was necessary to keep the structured questionnaire instrument relatively short as a full questionnaire would not have been feasible. Replicating every question from the scales identified in the research would have required respondents to answer over 150 questions, which was not possible for staff given the heavy workloads and short break times of aged care workers. A shorter questionnaire was considered appropriate given the explanatory nature of the research.

Table 3.6 Constructs and their sources

Construct	Source
Safety participation	Zohar 2010
Proactive care	Tuffrey-Wijne 2008
Perceived organisational support	Eisenberger 1986
Supervisor support (leader–member exchange)	Graen et al. 1995
Employee wellbeing	Diener et al. 1985
Employee stress	COPSOQ 2003
Managerialism (micro-management)	Graen et al. 1995
Autonomy	Asakura et al. 2016
Teamwork	Valentine et al. 2015
Psychological capital	Luthans et al. 2007
Resource adequacy	COPSOQ 2003
Turnover intention	Radford et al. 2015
Affective Commitment	Allen & Meyer 1990
Autonomy	Asakura et al. 2016
Meaning	Yen et al. 2011
Compassion	Rafnsdottir and Gudmundsdottir 2004
Relatedness	Caprara et al. 2012
Empathy	Castilho et al. 2015
Competence	Akamine et al. 2013
Engagement	Rafnsdottir and Gudmundsdottir 2004
Wellbeing	Diener et al. 1985

The final instruments items and survey can be found in Appendix 1. The reliability/validity of the survey is discussed in the next section. In terms of the reliability and validity scores for each item from previous research, this can be viewed in the relevant paper referenced or exemplar that has used them in previous research.

As the survey was completed in person as a pen-and-paper questionnaire guidance was taken from Meert et al. (2012) on the layout of the survey instrument, as the order of items sets up a specific temporal flow for the participants. Meert et al. (2012) suggest that respondents tend to answer questions in the order they are presented, even if they are able to respond in any order they choose. General ordering of the items was made in the following categories: perceived organisational support, manager supervision, wellbeing, affective commitment, competency, engagement, proactive care, stress at work, positive computing capability and positive computing care. This was influenced by Dillman (2007), who recommended "easing the cognitive burden of responding to a questionnaire given the time and work pressures the survey

respondents were under". As this survey instrument is new and not tested in a research project before, testing the validity and reliability was important and is discussed in the next section.

3.4.5 Validity and reliability

The validation of a survey instrument is essential to providing researchers clarity on their findings and to enable in-depth analysis (Bagozzi 1980; Straub 1989). Yin (2014) identifies three dimensions of research validity: construct, internal and external. Reliability is an assessment of whether comparable research using the same processes would lead to consistent conclusions (Yin 2014). Instruments that have been validated offer improved comparative research in the field of management information systems (Hunter et al. 1983). Dillman et al. (2009) recommend pre-testing an instrument to validate the readability, usability and applicability of the questionnaire. Given that the survey instrument was developed from scratch for this research, testing was critical to ensure its validity.

To ensure a survey instrument is validly designed and constructed, two elements need to be considered: content validity and face validity. Content validity refers to how well the content of a construct is reflected in the scales chosen to represent it (Neuman 2003, p. 192). To do this well, as Hinkin (1998) notes, a considerable review of relevant research must inform the design of scales. Face validity, on the other hand, relates to how well the indicator measures the relevant construct (Neuman 2003, p. 192), or in other words the questions should ascertain the necessary data.

At least three items are required to ensure a measure represents a construct adequately, though more are preferable (Hinkin 1998; Ping 2004). If a measure has many items, it can produce stronger validity but Hinkin (1998) notes that respondents can become disengaged. Face validity can be further improved, according to Hinkin (1998, p. 108), when survey questions are expressed in ways that are simple and familiar to the relevant target respondents.

Content experts are often relied upon by researchers who focus on quantitative methods. These experts evaluate the measurement properties of the instrument as a whole, as well as its component survey items (Meert et al. 2012). Content experts, according to Grant and Davis 1997, p. 269, see also Meertet al. 2012), are necessary for the development of a measurement tool and the process of validating new instruments. They also acknowledge that another essential component to validating content is to conduct an instrument review with a sample of

participants from the target population (Grant & Davis 1997, p. 273). However, the distinction between 'content experts' and research participants is not explored by Grant and Davis. In the context of aged care, where the sample included aged care workers, the implications of differentiating them from 'content experts' is not articulated. This research used a variety of content experts who were able to judge the measurement properties, including aged care staff who work in residential aged care, and lecturers and health researchers.

To ensure both forms of validity before a study, Hinkin (1998) suggests a pre-test by providing the questions to a small sample group who provide feedback on the survey's efficacy. Pre-testing of the structured questionnaire instrument was done in two phases. During the first phase, subject matter experts including a supervisor of this thesis as well as research colleagues at UTS were consulted. This phase was to ensure readability, relevance and applicability of the survey questions to the research questions. The second phase took place with three aged care staff at a Sydney-based not-for-profit aged care organisation, who reviewed the survey instrument to ensure participants could understand and interpret the questions and answer them accurately. The main concern raised during these phases was the length of time it would take to complete the structured questionnaire, which was approximately 20–25 minutes.

Common Method Variance

Common method variance "is the variance caused by the measurement methods used by the researcher, rather than the constructs representing the measures" (Podsakoff et al. 2003). In quantitative analysis it is essential to account for the methods used in order to determine the degree to which they influence or impact the research findings. A "large number of quantitative studies in information systems (IS) reflect on the potential impacts of common method variance on the conclusions of the research" (Aguirre-Urreta and Hu 2019).

Two important "consequences may result if common method effects employed in empirical research are not taken into consideration" (MacKenzie & Podsakoff 2011). 1) "The assessment of the reliability and validity of the measures used can arise where systematic variance in the measures exists" 2) "Systematic common method variance can also result in a level of bias in the assessment of the connections between constructs". According to Podsakoff (2003), "common method variance in a sample may lead to two results. Data analysis may lead to a single factor, or one factor may appear to explain the variance between most variables" (Podsakoff et al. 2003).

In this thesis, to assess the level of common method bias a Harmans single factor test was carried out. A Multi Collinearity VIF analysis was done as well as multivariate normality check, the results of which are discussed in Chapter 4.

3.4.6 Self-reporting survey limitations

Organisational and psychological factors are frequently researched using a self-report survey approach. However, this approach has the potential for self-report bias as respondents may seek to please the researcher or answer questions in ways to present themselves favourably (Donaldson & Grant-Vallone 2002, p. 247). Another limiting factor can be unintentional representation, which can occur when a respondent has a limited capacity to assess themselves (Salters-Pednealt 2020). Research and design can also lead to issues in a self-reporting survey. Questions that are misunderstood or poorly written can lead respondents to unintentionally misrepresent their views or experience. Another limiting factor can be the rating scales used. Yes or no answers, for example, often lack nuance while Likert scales can result in conservative or extreme responses. Biases, such as response and sample biases, can also have an impact on the reliability of collected data (Salters-Pednealt 2020).

Temporal considerations also present limitations to self-reporting surveys. Temporal elements are also important in order to avoid unnecessary respondent burden (Briller et al. 2008), particularly in an aged care context where pressures of workload can vary considerably throughout a work shift. Qualitative research methods enable and engage with the non-linear, discursive thinking processes of participants, which is more difficult to accomplish using quantitative methods (Meert et al. 2012).

Self-report bias can be minimised in surveys if the researcher gives consideration to the characteristics of respondents, the level of sensitivity of a measured construct, and situational pressures (Donaldson & Grant-Vallone 2002).

A comprehensive review of the literature was conducted to develop measures in this quantitative study. The results of the quantitative analysis were also further explored with the qualitative data. Statistically significant relationships identified during quantitative analysis produced themes that were used to code data from the qualitative phase. These were used to assess the divergence and convergence between the qualitative data and quantitative results and were also reviewed, as outlined in Chapter 5.

3.4.7 Summary of the quantitative approach

This thesis used a questionnaire instrument for the quantitative component of research. The questionnaire was improved through EFA and CFA, corresponding to the manifestation of positive computing in the aged care workforce. Structural equation modelling analysis is used to test the hypothetical relationships.

3.5 Methods research design: Qualitative studies

This section discusses the second phase of the research, the qualitative study. The qualitative study was designed to further explore key findings and themes from the first phase, the quantitative study. There are two main advantages to performing qualitative research. First, the data is based on human experiences and observations. Second, it increases opportunities to develop empirically supported new ideas and theories that are of greater relevance and interest to researchers (Conger 1998). Qualitative methods can be used to interpret social phenomena from the perspective of those involved and can improve the development of questionnaires (Ospina 2004). Qualitative research explores complex research questions that would be difficult to answer using quantitative research (Ospina 2004).

Qualitative data collection includes methods such as semi-structured or unstructured question responses. According to Cibangu (2012), qualitative research includes ethnography, logic, case studies, discourse analysis and semi-structured and open-ended interviews, among many others.

Qualitative research is based in the interpretation of social reality and is focused on describing people's lived experiences (Atkinson et al. 2001). Because of the focus on social factors, this type of research has had profound effects on research in nursing, health care, education, psychology, anthropology, sociology, information systems and management research (Denzin & Lincoln 2005). Qualitative research seeks to achieve a 'deep understanding of the particular' (Domholdt 1993). By using qualitative methods, this thesis seeks to explain the findings from the quantitative phase.

As an explanatory mixed methods design, a second, qualitative stage was used to interpret and explain the quantitative findings. This study conducted semi-structured interviews with 36 aged care workers at the aged care organisation in Western Australia. Interview questions were

created once the quantitative analysis was complete. The quantitative analysis results were also used to code and analyse the data collected during qualitative interviews.

3.5.1 Semi-structured interviews

Qualitative interviews are typically either in-depth or semi-structured. This research conducted semi-structured interviews. Semi-structured interviews use a series of open-ended questions focusing on issues relevant to the research area. In-depth interviews often explore one or two areas of focus in greater depth. Both approaches facilitate responses to questions the researcher may not expect or foresee.

Semi-structured interviews allow interviewers and respondents to discuss and develop points of focus during the interview (McMurray et al. 2004). This flexibility also allows the researcher to use various question types, including questions that are closed, open-ended, probing, leading, or neutral (McMurray et al. 2004).

One important factor in conducting interviews is the location in which an interview is held. In a study of people who care for dementia patients, researchers interviewed participants on their 'home ground' (Chung et al. 2008). Meeting participants in a familiar setting allows the researcher to engage with participants more naturally and helps ensure participants feel more relaxed (Moriarty 2011, p. 9). In this research, all interviews were conducted with aged care workers in a familiar setting, their places of work, usually in a quiet meeting room. This ensured they were focused on answering questions and not distracted by having to care for residents.

3.5.2 Sampling frame

Sample sizes in qualitative research are usually small. 'Saturation' is a term used in reference to sample size (Hammarberg, Kirkman & de Lacey 2016, p. 500). Data saturation describes circumstances where the data used does not provide any new information or risks being repetitive without serving any purpose (Charmaz 2005). Some researchers have questioned the legitimacy of saturation as a marker of sampling adequacy (O'Reilly & Parker 2013). Hammarberg, Kirkman and de Lacey (2016, p. 500) warn that pursuing saturation does not necessarily provide an insight into the diverse range of views and perspectives on a given experience. There are a number of sampling strategies, including convenience, theoretical, purposive, snowball or homogenous. This research used homogenous sampling which selects

participants who meet a specific criteria who can provide specific insight on a particular issue or area of study (Hammarberg, Kirkman & de Lacey 2016, p. 500).

3.5.2.1 Recruitment for interviews

The 36 respondents interviewed in this phase were selected from the aged care workers who were available and on shift at the facilities of the aged care organisation. Respondents were aged care workers or nurses who were actively providing care to residents. The staff interviewed held one of the following roles: carer (official job title: care partner), enrolled nurse (trainee nurse) or registered nurse (fully qualified nurse). There was one exception to these job categories; the final interviewee was the organisation's occupational work health and safety manager. Table 3.7 summarises the four types of respondents,

Table 3.7 Interview participants by job title

Job title	Role description	Number
Aged care partner	Care for residents	26
Enrolled nurse	Nurse in training	5
Registered nurse	Qualified senior nurse	4
Work Health and Safety Manager	On-floor manager	1
Total		36

All 36 respondents were on shift during the interview. With the cooperation of the aged care organisation management, participants took time away from their duties to participate in the interviews. Aged care workers were approached by the researcher and offered an opportunity to participate in an interview. Prior to their involvement, the purpose and conditions of the research were explained, including the anonymity of all respondents. They were given a Participant Information Statement (see Section 3.6).

The 36 participants, selected at aged care facilities in Perth, had all previously taken part in the quantitative research. Three to four volunteers from each site at the aged care organisation were requested and a schedule of volunteers was agreed with the head of quality and safety. The aged care organisation management requested that the interviews be completed during working hours and on site. Participants were not paid anything extra for their time as doing so may have altered or compromised participants' bias. Both staff and management volunteered their time within working hours with no financial incentive beyond their usual pay. I am grateful to both staff and management for their participation.

3.5.2.2 Interview questions

Types of questions which can be used in qualitative research are summarised in Table 3.8.

Table 3.8 Question categories

Question categories	
Closed questions	Questions that need only a yes/no reply and do not invite elaboration.
Open questions	Questions that allow a degree of interpretation, inviting the respondent to provide general information, often for the purpose of learning their perspective or understanding of an issue.
Probing questions	Questions that give a respondent the opportunity to elaborate on, clarify or emphasise a particular point.
Leading questions	Questions that imply or suggest a desired answer.
Neutral questions	Questions that do not imply a correct response and are not leading. They are intended to get a true representation of a respondent's opinion or view.

Source: McMurray et al. (2004, pp. 197–199).

The qualitative research interviews were based on a series of 16 questions listed in Table 3.9. Probing questions were asked when initial responses required more detail. For some respondents, questions required clarification; for example, the terms 'innovation' and 'positive computing' had to be explained and respondents often used technology instead of positive computing. Some interviewees began discussing their use of technology at home and had to be reminded that the questions only related to their work at the aged care organisation.

Table 3.9 Interview questions

Question	Type
Please describe your role at the aged care organisation.	Closed
Based on your experience, describe how technology can impact your wellbeing at work.	Open
Describe the aspects of technology at work that impact your wellbeing.	Open
What types of technology would help your wellbeing at work?	Open
In your experience, can technology impact staff commitment to working for the aged care organisation?	Open
What, in your experience, are the obstacles to having more technology in the work environment at the aged care organisation?	Open/probing
What could be done to overcome these obstacles?	Open/probing
Based on your experience, describe how technology can help support your care for residents.	Open
In your experience, can technology help you provide better care for residents?	Open
In your experience, what is the impact of technology on your work competence skills?	Open
In your experience, does management understand the impact of technology on the wellbeing of staff?	Open/probing
In your experience, does technology make you feel more connected/relate better to the aged care organisation and its goals and purpose?	Open/probing
In your experience, what is the impact of innovation on staff commitment?	Open/probing
In your experience, what are the benefits of innovation to the aged care organisation?	Open/probing
In your experience, what are the impediments to innovation at the aged care organisation?	Open/probing
In your experience is there a link between innovation, technology, carer wellbeing and the quality of care?	Open/probing

3.5.2.3 Interview administration

Participants of the semi-structured interviews were invited from the list of carers who had completed the structured questionnaire during the quantitative phase of research. Three to four participants from each site attended the interviews individually. The face-to-face interviews were held during working hours, in the residential aged care centres where the participants were working. Questions were asked in the order presented in Table 3.9. Where insufficient detail was provided, probing questions were also asked. The interviews were audio recorded using two devices. The shortest interview ran for 12 minutes and the longest interview was 52 minutes. The average interview length was 28 minutes. Given the nature of how the carers worked, it would have been very difficult to have longer interviews.

3.5.3 Overview of Analysis Process

This section provides an overview of the actual process taken during the qualitative analysis phase. Interviews were conducted to collect qualitative data, which was used to explore, analyse and explain the findings from the quantitative study. Data was collected from interviews with 36 residential aged care workers at the aged care organisation in Western Australia, followed by a discussion of the themes revealed during the interviews. Total interview time was approximately 18 hours, with an average of 28 minutes per interview. All interviewees were participants in the quantitative survey data collection.

For the purposes of confidentiality, because the interviews were recorded, names and demographic details were not taken. Interviews were recorded and transcribed for analysis. Qualitative data analysis was conducted in NVivo 11, arguably the most popular qualitative data analysis software. NVivo provides a range of tools for qualitative data analysis, including straightforward and easy to use coding tools, as well as complex tools for managing and sorting the data, running detailed queries, and visualising and reporting the results of the analysis.

The interviews were entered into NVivo in a disassembly phase, during which the interviews were coded using a design to enable comparison and contrast of the results from the quantitative analysis with the results from the qualitative interviews.

The design in NVivo used the nodes outlined in Table 5.1 to search and find text from the qualitative interview transcripts that related to or contrasted with the quantitative data results. Several important issues emerged that were either brought up by multiple participants or were mentioned many times (or both). Data was grouped in three major nodes: barriers, advantages and positive attitudes toward computing, and other background information.

The process of coding started with “labelling segments of the interview transcripts with relatively detailed and descriptive” (Miles & Huberman 1994) codes. These codes, which are referred to as either “in vivo” (Glaser & Strauss 1967) or simply “initial” (Charmaz 2014) codes in grounded theory coding, describe the data at the surface level and require little inference beyond it. This initial kind of coding helps to sort and organise data, as well as “sets up a relationship with your data, and with your respondents” (Star 2007, p. 80). Although neither the design of this current study nor the approach to qualitative data analysis could be described as grounded theory, it was felt that adopting some elements of this approach would help to generate more insights into the data.

Coding the data with these detailed and descriptive codes was applied for the first few interview transcripts, and after interview 7 there was no need to create new codes, as the subsequent data could be fully covered by the existing codes this is when saturation was evident. The concept of saturation has attained widespread acceptance as a methodological principle in qualitative research. It is commonly taken to indicate that, on the basis of the data that have been collected or analysed hitherto, further data collection and/or analysis are unnecessary. Despite the concept of saturation having apparently attained something of the status of orthodoxyin qualitative research, in the literature saturation is defined "in varying ways—or is sometimes undefined—and raises a number of problematic conceptual and methodological issues" (Dey 2003; O'Reilly and Parker 2013). Saunders et al. (2018), for example, raise the question of "when in a research process saturation is sought, and how to assess whether it has been achieved".

In the case of this research, saturation point was not sought or reached. Limited research in the area of positive computing and the newness of the survey required the collection of as much and as diverse a range of data as possible within the constraints of the research. The fixed number of 36 interviewees resulted in different responses that had some similarities and overlap. However, no saturation point was pursued or detected, and each interviewee provided a relatively unique view of positive computing.

Before coding the data from the subsequent interviews, the codes were scrutinised in order to reduce their number. The coded interview transcripts were reviewed and re-read several times and the codes were visually analysed. The purpose of this step was to ensure that the created codes accurately described the coded data and that there were no duplicates, or codes which covered the same content but were worded differently. Duplicates were eliminated by 'merging' two or more similar codes into one, which also resulted in the codes gradually becoming more inclusive. Next, these descriptive codes were organised into "parent–child" relationships, which is a term used in NVivo to refer to the hierarchical organisation of codes.

As the subsequent transcripts were read and coded, the process involved increased analytic thinking and interpretation. Through merging, the codes were gradually transformed from initially descriptive codes into more inclusive and "interpretive" (Punch & Oancea 2014) codes used to further categorise, as well as synthesise and conceptualise the existing coding framework. The above processes took place throughout the data analysis. At the same time, the processes of merging and re-naming codes was also constantly taking place.

3.5.4 Member checking

A risk with qualitative research is researcher bias. One potential source of "researcher bias arises where the qualitative researcher is both the data collector and analyst" (Miles & Huberman 1994) which was the case with this study. According to Mason (2002), "in these cases there is a potential that researchers may impose their own views on the research process at any stage, which may override or silence the participants' voices"(Mason 2002). The issue of how "to maintain trustworthiness in qualitative research has been an active question at least since the 1980s" (Lincoln & Guba 1985; Guba & Lincoln 1989; 1981).

To reduce the risk of bias it may be addressed by involving participants in the confirmation of results, an approach known as "member checking". This may also be referred to "as participant or respondent validation". According to Doyle (2007), "member checking is one approach that enables the researcher to ascertain the validity or trustworthiness of results". In the case of this study with the 36 participants limited member checking was done and interviews were offered to participants in confidence. In some cases, participants heard part of their recordings of their interviews to confirm they were satisfied with those recordings.

The process of member checking "can raise ethical concerns regarding the protection of participants and regarding whether the voice of participants should take precedence in the form of direct quotations, or whether the researcher's voice should be prioritised in the form of data interpretation" (Fossey, Harvey, McDermott, & Davidson, 2002). Ethical consideration is "therefore given in terms of how to protect participants, and consent procedures are intended and implemented to ensure the best outcome for them" (Dickenson-Swift, James, Kippen, & Liamputtong 2007). Ethical approval was provided by UTS, the aged care organisation and the interview participants. The researcher also emphasised the confidentiality of the interviews and data collection and storage to the interviewees and their consent was also requested and given.

3.5.5 Method of analysis

The volume of data collected during qualitative research complicates its analysis. The researcher must conduct an in-depth analysis while presenting their findings in a way that is concise and logical (Clifford 1997). Intensive data analysis begins after all the data has been collected and prepared. The transcripts for each interviewee are read thoroughly and

completely. In this case, the transcripts of the 36 interviews were reviewed. The aim is to discover any interesting patterns in the data (Hammersley & Atkinson 1983).

The main purpose of qualitative analysis is to investigate the manifest and latent content of communication. The manifest content of a communication is its intended and easily understood meaning, that is, content that is easily perceived (McMurray et al. 2004). By comparison, latent content is not as readily perceived (McMurray et al. 2004, p. 207). Researchers must be able to extract both manifest and latent content from interviews.

Yin's (2012) five-phase cycle was used in this study to extract latent and manifest content. This cycle is appropriate for computer-supported analysis and incorporates previous qualitative analysis techniques. NVivo 11 software was used during qualitative analysis to generate and organise the data through a combination of coding and assigning attributes to transcripts.

Patterns are identified by the researcher in first reading over the transcripts, as they relate to the research questions, the literature reviewed and emerging ideas that may not have previously been reported in the literature. Transcripts are closely examined for words, phrases or whole sentences that may be associated with the subject of research. Over time, patterns in the data are identified and categorised by theme. Yin describes five iterative stages of quantitative analysis: "database compilation, data disassembly, data reassembly, data interpretation and conclusion" (Yin 2012, p. 178). The following sections outline each element in Yin's (2012) cycle as they apply in this research.

3.5.5.1 Data compilation

The aim of data compilation is to allow the researcher to access and use the data during analysis and data disassembly. There are a number of approaches to data compilation suggested by Yin (2012) to achieve a logical order that is accessible and systematic. Suggested approaches include ordering the data with regard to theme or chronologically. In this study, the 36 audio recordings were transcribed and the text was organised according to themes related to the research framework.

The process of coding begins by labelling segments of interview transcripts with relatively detailed and "descriptive" (Miles & Huberman 1994) codes. The software tool used for coding is called NVivo, which has its origins in grounded theory coding, where the codes are referred to as either "in vivo" (Glaser & Strauss 1967) or "initial" (Charmaz 2014). The codes describe

the data at the surface level and require little inference beyond that. This initial coding helps sort and organise data and "[set] up a relationship with your data, and with your respondents" (Bos et al. 2007, p. 80). The transcriptions were imported into NVivo 11 to conduct qualitative data analysis. NVivo provides a range of tools for qualitative data analysis, including the capability to automatically catalogue the sources alphabetically, straightforward and easy-to-use coding tools, and complex tools for managing and sorting the data, running detailed queries and visualising and reporting the results of the analysis.

3.5.5.2 Data disassembly

The data was organised according to themes related to the research framework. As a result, the second step in the data disassembly process required identifying and applying themes and codes to the qualitative data. This process is similar to open coding (Strauss & Corbin 1998) in which the researcher develops themes through the period of data analysis. It is essential that researchers maintain a broader view when analysing their data in order to detect patterns and markers during the reassembly of data (Yin 2012, p. 191).

In this research, data disassembly was conducted when responses were analysed for initial "nodes", where a node is a term used in NVivo 11 to describe when a theme or code has been assigned to specific data segments. During quantitative analysis, important themes and markers were identified and these were applied to relevant interview responses. Once the initial analysis was complete, sub-nodes were developed to refine the analysis further. Some were linked to categories that were already being used, while others warranted a new category.

3.5.5.3 Data reassembly

The third step in the process is data reassembly. During this step, the data is reassessed using the codes developed during disassembly. This allows for new and more conceptual ways of reviewing the data, by linking themes and concepts and identifying how they relate to each other. Through the process of creating subcategories of codes and linking those subcategories with others, qualitative researchers create matrices that are complex and can be hierarchical (Yin 2012). These relationship arrays are useful for comparing themes that arise from different data sources and are also useful for organising codes into hierarchical "parent–child" relationships, a term in NVivo to describe codes that are higher or lower in a hierarchy.

While observing similarities and dissimilarities in the data in order to develop relevant categories and subcategories, Yin (2012, p. 196) expresses the importance of being aware of "negative instances" where items might appear similar but, upon closer review, are importantly different. Yin has argued that it may therefore be necessary for the researcher to revise explanations of early observations (2012, p. 197). Such an approach helps to identify additional themes that might not be immediately apparent on first analysis, thereby broadening the research (Yin 2012, p. 199). These techniques are essential for a researcher when reassembling data to make sure the codes and categories used are thorough, robust and reflective of more than just an initial analysis.

One factor that should be taken into account in data reassembly, and which the above techniques help to avoid, is the high number of "discretionary choices" from the researcher, which means the data is open to the risk of bias (Yin 2012, p. 196). To reduce this risk and identify and minimise biases, Yin (2012, p. 196) suggests the researcher should make constant comparisons, use rival thinking, and review findings for negative instances.

The data reassembly phase requires segments of coded text that discuss the quantitative findings to be analysed. To assess what parts of the highlighted text provide the most comprehensive description of the theme, comparisons with responses from interview participants were also made.

3.5.5.4 Data interpretation

During the data interpretation phase, the researcher applies what might be described as a narrative to explore and explain the themes as they are supported by the evidence. The researcher projects their view and meaning onto the data they have compiled (Yin 2012, p. 207). The narrative projected by the researcher must be informed by the interpretation of data, should reflect what other researchers might reasonably conclude (Yin 2012, p. 207), and should balance insights and add value for the researcher. This research merged codes to shift them from the initial descriptive nature of the codes into more expansive and "interpretive" codes (Punch & Oancea 2014). These were then used to further categorise, synthesise and conceptualise the existing coding framework.

3.5.5.5 Concluding phase

After assessing the data, applying codes and categories and a thorough interpretation of the data, the final step in the qualitative research is to draw conclusions by linking the interpretation with the empirical findings. This can be described as refining the findings into a series of claims and statements that synthesise that data into the "highest conceptual level" that the analysis allows (Yin 2012, p. 220). This is also an opportunity for the researcher to consider the implications and significance of their work in a broader context and for future practice (Yin 2012).

3.5.6 Limitations of qualitative research

Despite the considerable strengths of qualitative research, there are also disadvantages to this methodology. Qualitative research can focus on experience and meaning while ignoring contextual sensitivities (Silverman 2014). Yet there is the risk that pure qualitative research may fail to provide insight to cultural and social constructions of variables (Richards & Richards 1994) because the data is usually gathered from a few individuals and cases, so it is not statistically representative and so generally leads to findings that cannot be scaled to larger populations. Further, the reliance on the skills of the researcher can lead to negative impacts on the data because research outcomes may be influenced by personal biases or idiosyncrasies (Richards & Richards 1994).

3.5.7 Summary of qualitative analysis process

Semi-structured interview responses from 36 aged care workers who had completed the survey were organised and interpreted using the five-phase qualitative analysis method (Yin 2012). After transcription, interviews were subjected to thematic coding. The processes described in Section 3.5 were undertaken continuously and iteratively throughout the data analysis. Generating detailed and descriptive codes took place while coding the first seven interview transcripts. The remaining transcripts required very few new codes to be generated, as saturation had been achieved and the subsequent data could be adequately covered by the existing codes.

3.6 Research ethics approval

The Human Research Ethics Committee of the University of Technology Sydney reviewed and approved the research phase of this study (UTS HREC 16-0671). Before participating in the research, all participants were informed about the nature of the study and that their involvement was voluntary. The survey in the quantitative phase did not include personal or sensitive questions, and during the analysis data from both the quantitative and qualitative phases was de-identified. In the qualitative phase, respondents were allocated an interviewee number in place of their name to ensure anonymity.

3.7 Conclusion

This chapter outlined the research paradigm and methods design of the study. First, it outlined the role of pragmatism as a research paradigm, noting that pragmatism brings a level of flexibility to research methodology design. This research uses an explanatory, sequential mixed methods design, including both quantitative and qualitative phases of study.

The first phase of research was the quantitative study. A survey instrument was developed to measure the manifestations of positive computing in the aged care workforce. From a sample of 148 aged care workers at the aged care organisation in Western Australia, EFA and CFA were used to validate the data. The results are discussed in the following Chapter 4.

The second phase of research was the qualitative study. This involved semi-structured interviews with 36 aged care workers at the aged care organisation aged care facilities. The five-phase method for qualitative analysis (Yin 2012) was used to arrange and assess qualitative data, explore the findings from the quantitative investigation and develop a number of relevant conclusions. Chapter 5 discusses the qualitative analysis in more detail and uses the findings from the quantitative analysis as themes to lay the foundation for the analysis of the qualitative data. The qualitative analysis is then used to build on, interpret and contextualise the initial quantitative data and triangulate the quantitative results.

Chapter 4: Findings from the quantitative study

4.1 Overview

This chapter presents the results from the quantitative study discussed in Chapter 3. The data collected from the aged care workers using the survey instrument was analysed using both EFA and CFA, and structural equation modelling analysis was then undertaken. The chapter concludes with a discussion on the findings from the analysis.

4.2 Descriptive analysis of sample

The demographic characteristics of the respondents are summarised in Table 4.1 below.

Table 4.1 Descriptive statistics for demographic characteristics

Variable		Frequency	Percent
Gender	Female	109	83.8
	Male	20	15.4
Age	19–29 years old	25	19.2
	30–39 years old	29	22.3
	40–49 years old	42	32.3
	50–59 years old	26	20.0
	above 60 years old	8	6.2
Position	Residential Aged Carer / Personal Carer / AIN	89	68.5
	Other	39	30.0
Highest education	High School	4	3.1
	Certificate III	51	39.2
	Certificate IV	20	15.4
	Bachelor degree	36	27.7
Length of employment	Less than 6 months	9	6.9
	6 months to 2 years	33	25.4
	2 to 5 years	44	33.8
	5 to 10 years	28	21.5
	More than 10 years	16	12.3
Employment type	Full-time	36	27.7
	Part-time	77	59.2
	Casual	16	12.3
English as first language	Yes	74	56.9
	No	56	43.1
Immigrant	Yes	71	54.6
	No	58	44.6
Total		148	100

The majority of respondents (84%) were female, and over half (52%) were aged 40–59 years. The majority of respondents (70%) identified themselves as a residential aged carer/personal

carer, and most respondents had post-school education, either through university or TAFE, with only 4% having only a high school education. The majority of respondents had been employed by the aged care organisation for less than five years. The majority of respondents were employed part-time. Over half of the respondents (57%) said English was their first language, and over half (55%) of all respondents identified themselves as a migrant, defined as being born overseas.

4.3 Examining the quantitative data

This section reviews the data against relevant statistical models to demonstrate the adequacy of the data. It is essential there are enough responses to create a sound basis for general and reliable results. There were 148 completed surveys of a maximum possible 204 responses, a response rate of 72.5%. The non-response of 27.5% was due to the complex employment arrangements of the remaining staff, including being on night shifts or on leave.

4.3.1 Common method bias

The raw survey data was input into SPSS 25 statistical analysis software. After the input of the data a missing data analysis was run and the results concluded that none of the sampled psychometric items had more than 1.0 % missing data (between 0–1.0% of missing entries per item), as such, where missing data was present, the item mean was imputed. Of the aged care employees who completed the surveys, approximately 8% of the sampled aged care employees were not directly involved in the day-to-day care of the residents, but had support jobs, including managers, cooks, kitchen assistants, leisure and lifestyle activities coordinators, and cleaners.

To test for common method variance in the data set a Harman's single factor test was run with the objective of testing to see if the majority of the variance could be explained by a single factor. Given this research used a newly developed survey instrument it was important to check for bias in the answers provided by the aged care staff who completed the survey to ensure the answers reflected their actual experiences. The Harmans single factor test measures the variance present for each of the survey's respondents. The results from this data set show that 37.01% of the variance was explained by one factor. Considering that a single factor does not account for the majority of the variance in the model, that is, it accounts for 37.01%, it can be

concluded that common method bias is not an issue. The results for the Harman single factor test are below:

Table 4.2 Harman single factor test results: Communalities

Communalities			
		Initial	Extraction
POS_1_1	cares about my opinion	1.000	.502
POS_2_1	cares about my wellbeing	1.000	.478
POS_3_1	considers my goals and values	1.000	.435
POS_4_1	provides help for me when I have a problem	1.000	.395
POS_5_1	would forgive an honest mistake on my part	1.000	.328
POS_6_1	would not take advantage of me	1.000	.467
a1	It is easy to use digital technology in my work	1.000	.287
a2	I can effectively complete my work using the available digital technology	1.000	.345
a5	Whenever I make a mistake using the technology I can recover quickly and easily	1.000	.227
a7	Using digital technology makes me feel like I am always on the job	1.000	.349
a8	Using digital technology reduces my fatigue level at work	1.000	.447
a9	The digital technology at my organisation reduces the amount of bureaucratic red tape and administration work	1.000	.480
a10	Digital technology helps me get my work done during staff shortages	1.000	.436
a11	Using digital technology makes me feel more satisfied with my work	1.000	.463
a12	Digital technology makes me feel very connected to the people in my organisation	1.000	.635
a13	Using digital technology helps me identify problems at work and work to resolve them	1.000	.562
a14	Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors	1.000	.417
a15	Digital technology helps me listen to residents' complaints or wishes and respond/cope appropriately	1.000	.485
a16	Digital technology helps me decide how to care for residents according to my own judgment as a carer	1.000	.506
a17	I can effectively complete my work using the available digital technology	1.000	.542

a18	We have meetings to discuss ways we can innovate and use technology better	1.000	.508
affect_com_1_1	This organisation has a great deal of personal meaning for me	1.000	.320
affect_com_2_1	I would be happy to spend the rest of my career with this organisation	1.000	.478
affect_com_3_1	I enjoy discussing my organisation with people outside it	1.000	.323
affect_com_4_1	I feel emotionally attached to this organisation	1.000	.500
affect_com_5_1	I feel a strong sense of belonging to this organisation	1.000	.429
affect_com_6_1	I feel strong ties to this organisation	1.000	.500
Proactive_care_1_1	I am able to recognise health problems in the residents that I care for	1.000	.004
Proactive_care_3_1	I closely monitor any changes in the physical weight of residents	1.000	.003
Proactive_care_4_1	I know what to do when I suspect a resident has a pressure injury	1.000	.056
Proactive_care_5_1	I can generally identify who is likely to get a pressure injury and monitor them accordingly	1.000	.023
well_being_1_1	Overall, I am reasonably happy with my work life	1.000	.431
well_being_2_1	Overall, I fulfil an important purpose in the work that I do	1.000	.083
well_being_3_1	Most days I feel a sense of accomplishment from my work	1.000	.140

Table 4.3 Harman single factor test results: Total variance explained

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	12.582	37.006	37.006	12.582	37.006	37.006
2	4.844	14.246	51.252			
3	2.697	7.933	59.185			
4	1.995	5.867	65.052			
5	1.492	4.390	69.441			
6	1.192	3.506	72.947			
7	.991	2.915	75.862			
8	.768	2.258	78.120			
9	.715	2.103	80.224			
10	.646	1.899	82.123			
11	.625	1.840	83.963			
12	.538	1.582	85.544			
13	.495	1.457	87.002			

14	.457	1.344	88.345
15	.409	1.202	89.547
16	.383	1.126	90.674
17	.346	1.018	91.692
18	.323	.950	92.641
19	.303	.893	93.534
20	.265	.780	94.314
21	.240	.705	95.019
22	.233	.687	95.706
23	.210	.616	96.322
24	.193	.568	96.890
25	.178	.523	97.413
26	.136	.399	97.812
27	.134	.393	98.205
28	.125	.369	98.574
29	.100	.295	98.868
30	.092	.270	99.138
31	.089	.262	99.400
32	.079	.231	99.631
33	.069	.204	99.835
34	.056	.165	100.000

Extraction Method: Principal Component Analysis.

Table 4.4 Harman single factor test results: Component matrix

Component Matrix[a]		
		Component 1
POS_1_1	cares about my opinion	.709
POS_2_1	cares about my wellbeing	.691
POS_3_1	considers my goals and values	.659
POS_4_1	provides help for me when I have a problem	.628
POS_5_1	would forgive an honest mistake on my part	.572
POS_6_1	would not take advantage of me	.683
a1	It is easy to use digital technology in my work	.535
a2	I can effectively complete my work using the available digital technology	.587
a5	Whenever I make a mistake using the technology I can recover quickly and easily	.476
a7	Using digital technology makes me feel like I am always on the job	.590
a8	Using digital technology reduces my fatigue level at work	.668
a9	The digital technology at my organisation reduces the amount of bureaucratic red tape and administration work	.693

a10	Digital technology helps me get my work done during staff shortages	.661
a11	Using digital technology makes me feel more satisfied with my work	.680
a12	Digital technology makes me feel very connected to the people in my organisation	.797
a13	Using digital technology helps me identify problems at work and work to resolve them	.750
a14	Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors	.646
a15	Digital technology helps me listen to residents' complaints or wishes and respond/cope appropriately	.696
a16	Digital technology helps me decide how to care for residents according to my own judgment as a carer	.712
a17	I can effectively complete my work using the available digital technology	.737
a18	We have meetings to discuss ways we can innovate and use technology better	.713
affect_com_1_1	This organisation has a great deal of personal meaning for me	.565
affect_com_2_1	I would be happy to spend the rest of my career with this organisation	.691
affect_com_3_1	I enjoy discussing my organisation with people outside it	.568
affect_com_4_1	I feel emotionally attached to this organisation	.707
affect_com_5_1	I feel a strong sense of belonging to this organisation	.655
affect_com_6_1	I feel strong ties to this organisation	.707
Proactive_care_1_1	I am able to recognise health problems in the residents that I care for	.062
Proactive_care_3_1	I closely monitor any changes in the physical weight of residents	.053
Proactive_care_4_1	I know what to do when I suspect a resident has a pressure injury	.237
Proactive_care_5_1	I can generally identify who is likely to get a pressure injury and monitor them accordingly	.152
well_being_1_1	Overall, I am reasonably happy with my work life	.657
well_being_2_1	Overall, I fulfil an important purpose in the work that I do	.289
well_being_3_1	Most days I feel a sense of accomplishment from my work	.374

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

4.3.2 Methods of data analysis

Data analysis was conducted using SPSS 20 and AMOS 20. EFA and CFA were performed to assess covariation in observed variables and to reduce observed variables to fewer latent variables (Schreiber et al. 2006). Factor analyses are diagnostic tools to determine whether measures have been accurate through an analysis of the data that has been collected (Matsunaga 2010, p. 99). Factor analyses are used to explore and confirm expected patterns in used items.

For factor extraction, principal component analysis (PCA) was conducted. As suggested by Matsunaga (2010), the Promax rotation method is “used to provide solutions with correlated components”. There are other rotation methods, such as the Varimax rotation method, which classify items in the way that the components are orthogonal between each other. In order to evaluate factorability of the items used, the Kaiser–Meyer–Olkin (KMO) sampling adequacy measure was used as it helps “to determine the degree to which correlation contains factors or is the result of chance” (Worthington & Whittaker 2006). To decide how many components or factors to retain, one of the most common rules was used: “the eigenvalue should be greater than one” (Kaiser 1960).

The total variance explained by components or factors should be at least 40%, although some authors recommend at least 75% (Reio & Shuck 2015). When determining which items to use, a “factor loading cut-off criteria was set at 0.40, in keeping with a widely used approach” (Matsunaga 2010; Reio & Shuck 2015). Further analysis was conducted on items with factor loadings above 0.40. When an item had major cross-loadings it was not included in further analysis. The criterion for exclusion was set on the basis of recommendations from Matsunaga (2010), who suggests retaining items where “their primary loading is higher than 0.5–0.6 and where the second highest factor loading is smaller than 0.2–0.3, meaning their primary–secondary discrepancy is sufficiently large (usually 0.3–0.4)”.

CFA was done to validate and confirm the factor structure obtained during the EFA. The reliability of the observed variables in the measurement model was influenced by random measurement error, as presented by the associated error terms in the model. Further, each of the observed variables was regressed onto its respective factor, which is shown to be “intercorrelated” as was suggested by the literature (Byrne 2010).

In order to evaluate overall model fit, chi-square test statistics are usually used. Taking into account that the chi-square test has been criticised for its sensitivity to sample size, “several alternative model fit indices can be used instead” (Byrne 2010; Worthington & Whittaker 2006) including the “$\chi 2$/degrees of freedom ratio” (Wheaton et al. 1977) and two groups of fit indices: “absolute and incremental fit indices” (Hu & Bentler 1999). The “absolute fit indices evaluate how well a prior models reproduce the sample data” (Hu & Bentler 1999) while the “incremental fit indices compare a baseline structural equation model against a specific structural equation model to determine the improvement in the fit of the model to the data” (Worthington & Whittaker 2006, p. 828).

Kline (2005) recommends that a "minimum of four indices are reported: the chi-square test statistics with corresponding freedom and level of significance, the Root Mean Squared Residual (RMSEA), the Comparative Fit Index (CFI) and Standardised Root Mean Square (SRMR)". Previous studies (Matsunaga 2010; Worthington & Whittaker 2006) followed the recommended minimum, and the same recommendations have been applied in this research.

To assess the construct validity of factors obtained in the measurement model, convergent and discriminant validity and reliability of the used constructs are tested. Construct validity refers to "the extent to which a set of manifest variables actually reflects the theoretical latent construct that they are designed to measure" (Talaja 2012, p. 324). There is convergent and discriminant validity. Convergent validity is present when manifest variables that belong to one construct share a high proportion of variance in common. There are several ways to evaluate convergent validity among items: by analysing factor loadings, by calculating the Average Variance Extracted (AVE) and by calculating the Composite Reliability (CR). High values of AVE indicate that the "latent construct accounts for a majority of the variance in its indicators on average" (MacKenzie et al. 2011, p. 313). Hair et al. (2010) and MacKenzie et al. (2011) suggest that if convergent validity of the used constructs exists then factor loadings should be statistically significant and at least 0.5, the value of AVE indicators should be above 0.5, and the value of CR should be above 0.7. The degree to which one construct can be considered distinct from others is its discriminant validity (Talaja 2012, p. 324). To determine the discriminant validity of the constructs that were used, there are several necessary conditions to be met: the value of the Maximum Shared Variance (MSV) should be below the value of AVE, and the "square root of AVE should be greater than the correlation values between the constructs" (Hair et al. 2010).

4.3.3 Output of the quantitative analysis

A quantitative analysis was conducted to analyse the survey responses. Multivariate analysis of EFA, CFA and structural equation modelling was used to analyse the survey data with SPSS and AMOS. The objective was to empirically test an instrument that could measure the impact of positive computing in an aged care context.

4.3.3.1 Exploratory factor analysis (EFA)

Principal component analysis (PCA) was conducted on 36 variables related to positive computing care, positive computing capability, affective commitment, proactive care, perceived organisational support and wellbeing. Results are in Table 4.2. The calculated value of the Kaiser–Meyer–Olkin measure (KMO = 0.888) was above 0.6, which is required for a good factor analysis (Worthington & Whittaker 2006). Bartlett's Test of Sphericity was also statistically significant ($p = 0.000$), which indicates the eligibility of the data used (Treiblmaier & Filzmoser 2010). Retention of items for further analysis was based on the recommendations of previous studies (Matsunaga 2010).

Table 4.5 Communalities for the 36 items

Items	Labels	Initial	Extraction
POS_1_1	cares about my opinion	1.000	0.850
POS_2_1	cares about my wellbeing	1.000	0.851
POS_3_1	considers my goals and values	1.000	0.818
POS_4_1	provides help for me when I have a problem	1.000	0.700
POS_5_1	would forgive an honest mistake on my part	1.000	0.666
POS_6_1	would not take advantage of me	1.000	0.665
POS_7_1	is willing to help me if I need a special favour	1.000	0.674
a16	Digital technology helps me decide how to care for residents according to my own judgment as a carer	1.000	0.814
a13	Using digital technology helps me identify problems at work and work to resolve them	1.000	0.839
a17	Digital technology helps to remind me that my work is meaningful and purposeful	1.000	0.780
a15	Digital technology helps me listen to residents' complaints or wishes and respond/cope appropriately	1.000	0.799
a11	Using digital technology makes me feel more satisfied with my work	1.000	0.819
a14	Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors	1.000	0.774
a10	Digital technology helps me get my work done during staff shortages	1.000	0.693
a9	The digital technology at my organisation reduces the amount of bureaucratic red tape and administration work	1.000	0.735
a12	Digital technology makes me feel very connected to the people in my organisation	1.000	0.775
a8	Using digital technology reduces my fatigue level at work	1.000	0.695
a7	Using digital technology makes me feel like I am always on the job	1.000	0.744
a18	We have meetings to discuss ways we can innovate and use technology better	1.000	0.586
a2	I can effectively complete my work using the available digital technology	1.000	0.788
a1	It is easy to use digital technology in my work	1.000	0.732
a5	Whenever I make a mistake using the technology I can recover quickly and easily	1.000	0.656
affect_com_6_1	I feel strong ties to this organisation	1.000	0.895
affect_com_5_1	I feel a strong sense of belonging to this organisation	1.000	0.869
affect_com_4_1	I feel emotionally attached to this organisation	1.000	0.859
affect_com_1_1	This organisation has a great deal of personal meaning for me	1.000	0.672
affect_com_2_1	I would be happy to spend the rest of my career with this organisation	1.000	0.791
affect_com_3_1	I enjoy discussing my organisation with people outside it	1.000	0.628
Proactive_care_1_1	I am able to recognise health problems in the residents that I care for	1.000	0.693
Proactive_care_2_1	I closely monitor any changes in the physical weight of residents	1.000	0.691
Proactive_care_3_1	I know what to do when I suspect a resident has a pressure injury	1.000	0.650
Proactive_care_4_1	I can generally identify who is likely to get a pressure injury and monitor them accordingly	1.000	0.824
Proactive_care_5_1	I am good at preventing injuries or infection in residents	1.000	0.632
well_being_1_1	Overall, I am reasonably happy with my work life	1.000	0.791
well_being_2_1	Overall, I fulfil an important purpose in the work that I do	1.000	0.723
well_being_3_1	Most days I feel a sense of accomplishment from my work	1.000	0.779

Note: Extraction Method: Principal Component Analysis.

Principal component analysis on the 36 items revealed the presence of five factors with characteristic values above one, the so-called Guttman–Kaiser criterion. These six factors explained 74.86% of the total variance, as shown in Table 4.6 below.

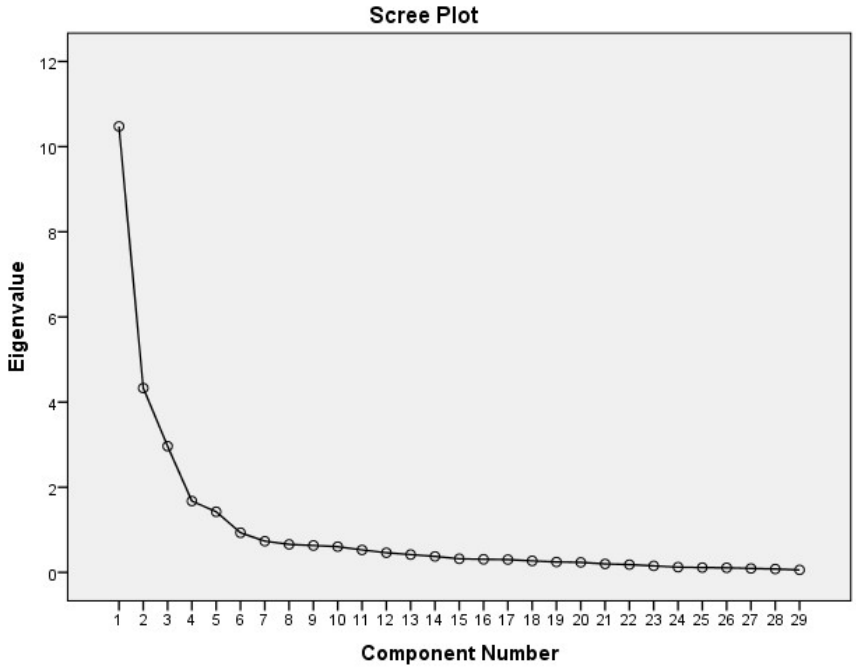
Table 4.6 Total variance explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	12.987	36.075	36.075	12.987	36.075	36.075	10.275
2	4.931	13.697	49.772	4.931	13.697	49.772	8.729
3	3.124	8.679	58.451	3.124	8.679	58.451	9.164
4	2.011	5.586	64.037	2.011	5.586	64.037	3.412
5	1.536	4.267	68.304	1.536	4.267	68.304	5.523
6	1.353	3.759	72.062	1.353	3.759	72.062	3.982
7	1.008	2.801	74.864	1.008	2.801	74.864	1.109
8	.801	2.224	77.088				
9	.769	2.135	79.223				
10	.698	1.939	81.162				
11	.637	1.768	82.930				
12	.593	1.648	84.578				
13	.522	1.451	86.030				
14	.493	1.369	87.399				
15	.428	1.189	88.588				
16	.414	1.151	89.739				
17	.378	1.049	90.788				
18	.326	.906	91.694				
19	.312	.867	92.560				
20	.303	.842	93.402				
21	.296	.821	94.223				
22	.259	.719	94.942				
23	.222	.616	95.558				
24	.210	.585	96.143				
25	.205	.571	96.713				
26	.180	.499	97.213				
27	.152	.422	97.635				
28	.133	.368	98.003				
29	.128	.356	98.360				
30	.119	.329	98.689				
31	.100	.278	98.967				
32	.089	.246	99.214				
33	.083	.231	99.445				
34	.078	.218	99.663				
35	.069	.191	99.854				
36	.053	.146	100.000				

Note: Extraction Method: Principal Component Analysis.
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Figure 4.1 shows a review of the scree plot. Taking into account the Cattell (1966) criteria, all six components were retained for further analysis.

Figure 4.1 Scree plot



Factor loadings from the principal component analysis are given in Table 4.7 along with the CFA factor loadings.

4.3.3.2 Confirmatory factor analysis (CFA)

The CFA structure has six factors: positive computing care, positive computing capability, affective commitment, perceived organisational support, proactive care and wellbeing. The second-order factor (positive computing) was introduced in the model and consists of two factors: positive computing care and positive computing capability. The model did not have good fit. Therefore, to improve the model fit, the modification indices were consulted. The regression weights and modification indices indicated that the model could be improved by making a number of alterations. One of the items of proactive care (proactive care 2 – I closely monitor any changes in the physical weight of residents) had a low correlation with the latent variable (below 0.5), and as such was removed. In addition, guided by the modification indices results, the following covariances were drawn between the errors statistics of:

- “Digital technology helps me decide how to care for residents according to my own judgment as a carer” (a16) and “Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors” (a14)
- “Using digital technology helps me identify problems at work and work to resolve them” (a13) and “Digital technology helps me listen to residents’ complaints or wishes and respond/cope appropriately” (a15)
- “Digital technology helps to remind me that my work is meaningful and purposeful” (a17) and “Digital technology helps me get my work done during staff shortages” (a10)
- “This organisation has a great deal of personal meaning for me” (Affective Com 1) and “I would be happy to spend the rest of my career with this organisation” (Affective Com 2)
- “Overall, I fulfil an important purpose in the work that I do” (Wellbeing 2) and “Most days I feel a sense of accomplishment from my work” (Wellbeing 3)
- [The organisation] “would forgive an honest mistake on my part” (POS 5) and “would not take advantage of me” (POS 6); “would not take advantage of me” (POS 6) and is “willing to help me if I need a special favour” (POS 7); and “would forgive an honest mistake on my part” (POS 5) and is “willing to help me if I need a special favour” (POS 7).

While there were numerous error covariances, it likely reflects the low sample size used in analysis. Following the deletion of the low weighted proactive care item, and the addition of the aforementioned covariances, the model had an overall acceptable fit. The model fit indices indicated that the model achieved a good model fit. Factor loadings from the CFA and mean values, standard deviations, and Cronbach’s alpha coefficients are given in Table 4.7.

Table 4.7 Results of EFA loadings, CFA loadings, Mean, SD and Cronbach's alpha

Components/Factors	EFA loadings	CFA loadings	Mean	SD	Cronbach's alpha
Positive computing care					
Digital technology helps me decide how to care for residents according to my own judgment as a carer	0.925	0.840	3.95	1.26	
Using digital technology helps me identify problems at work and work to resolve them	0.873	0.846	4.16	1.27	
Digital technology helps to remind me that my work is meaningful and purposeful	0.869	.880	3.96	1.28	
Digital technology helps me listen to residents' complaints or wishes and respond/cope appropriately	0.867	.801	3.88	1.35	
Using digital technology makes me feel more satisfied with my work	0.896	.860	3.98	1.33	
Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors	0.867	.772	4.02	1.25	.957
Digital technology helps me get my work done during staff shortages	0.850	.825	3.53	1.39	
The digital technology at my organisation reduces the amount of bureaucratic red tape and administration work	0.805	.815	3.96	1.26	
Digital technology makes me feel very connected to the people in my organisation	0.751	.875	3.83	1.38	
Using digital technology reduces my fatigue level at work	0.789	.752	4.05	1.34	
Using digital technology makes me feel like I am always on the job	0.601	.651	4.08	1.18	
We have meetings to discuss ways we can innovate and use technology better	0.563	.690	3.74	1.30	
Perceived organisational support					
cares about my opinion	0.908	.929	4.21	1.243	
cares about my wellbeing	0.907	.937	4.38	1.265	
considers my goals and values	0.883	.882	4.17	1.202	
provides help for me when I have a problem	0.804	.769	4.42	1.055	.922
would forgive an honest mistake on my part	0.599	.559	4.21	1.192	
would not take advantage of me	0.643	.704	4.18	1.273	
is willing to help me if I need a special favour	0.721	.663	4.02	1.306	
Positive computing capability					
I can effectively complete my work using the available digital technology	0.818	.867	4.81	0.89	
It is easy to use digital technology in my work	0.798	.821	4.75	0.94	.805
Whenever I make a mistake using the technology I can recover quickly and easily	0.727	.616	4.72	0.81	
Affective commitment					
I feel strong ties with this organisation	0.919	.962	3.78	1.47	
I feel a strong sense of belonging to this organisation	0.960	.944	3.90	1.45	
I feel emotionally attached to this organisation	0.868	.915	3.72	1.41	
This organisation has a great deal of personal meaning for me	0.799	.825	3.98	1.36	.938
I would be very happy to spend the rest of my career with this organisation	0.736	.739	3.85	1.52	
I enjoy discussing my organisation with people outside it	0.769	.700	3.48	1.40	
Proactive care					
I can generally identify who is likely to get a pressure injury, and monitor them accordingly	0.827	1.001	5.28	0.58	
I know what to do when I suspect a resident has a pressure injury	0.782	.702	5.36	0.53	.846
I am good at preventing injuries or infection in residents	0.705	.679	5.20	0.56	
I am able to recognise health problems in the residents that I care for	0.812	.575	5.19	0.62	
Wellbeing					
Overall, I fulfill an important purpose in the work that I do	0.922	.501	5.09	0.68	
Overall, I am reasonably happy with my work life	0.446	1.058	4.52	1.07	.756
Most days I feel a sense of accomplishment from my work	0.839	.457	4.89	0.76	

In order to test discriminant and convergent validity of used constructs, "values of Composite Reliability (CR), Average value of Variance Extracted (AVE) and Maximum Shared Variance (MSV) were calculated" (Lukić & Lukić 2018). Kline (2011) suggests that when the measurement model is correct, the obtained results should show the following: "1) all indicators specified to measure a common factor have relatively high standardised factor loadings on that factor (e.g., > 0.7); 2) estimated correlations between the factors are not excessively high (e.g., < 0.9 in absolute value). The first indicates there is convergent validity and the second indicates there is discriminant validity" (Lukić & Lukić 2018).

The values of "Composite Reliability (CR), Average value of Variance Extracted (AVE), Maximum Shared Variance (MSV) and Average Shared Variance (ASV) were used to test discriminant and convergent validity" (Lukić & Lukić 2018). The following conditions needed to be filled to confirm the convergent (CR > 0.7; AVE > 0.5; CR > AVE) and discriminant validity of constructs (MSV < AVE; ASV < AVE).

The results are shown in Table 4.8 below.

Table 4.8 Results of validity and reliability testing

	CR	AVE	MSV	MaxR(H)	Well_ Being	Positive _comp uting	POS	Proact_ Care	Affec.Co mm
Well_Being	0.741	0.526	0.359	1.129	**0.726**				
Positive_computing	0.724	0.571	0.345	0.760	0.512	**0.755**			
POS	0.918	0.622	0.394	0.954	0.599	0.587	**0.789**		
Proact_Care	0.836	0.572	0.099	1.002	0.066	0.233	0.180	**0.756**	
Affec.Comm	0.941	0.728	0.394	0.968	0.559	0.449	0.628	0.315	**0.853**

Note: CR = Composite Reliability; AVE =Average Variance Extracted; MSV = Maximum Shared Variance.

As data was collected using a single instrument, a Harmans single factor test was used to test common method bias (see Section 4.3.1). The results from this data set show that 37.01% of the variance was explained by one factor. Considering that a single factor has not accounted for the majority of the variance in the model, it can be concluded that common method bias is not an issue.

4.3.3.3 Outliers

Outliers were present and an analysis was done. After analysis, these outliers were found to be data entry errors from the initial input to SPPS. The outliers were removed by correcting the data that was input incorrectly.

4.3.4 Unidimensional Scale

Researchers interested in measuring attitudes to science frequently employ summated ratings scales, often consisting of a set of items (e.g., opinion statements), each followed, for example, a by a 5-point or 6-point scale (which was used in this study) . The key advantage of using a set of items rather than a single item, is that it improves the reliability of measurement. If the method is to "produce meaningful scores, the items must all be indicators of some common underlying construct; its items should share common variance", that is, "the scale must display unidimensionality" DeVellis (1991). According to DeVellis (1991, p. 25), "a unidimensional scale or a single dimension of a multidimensional scale should consist of a set of items that correlate well with each other". Factor analysis provides evidence that supports the claim that a scale is unidimensional. A finding that all the items have substantial loadings on a single factor can be used to justify adding the item scores together to generate a single scale score whch was the case with this study the factor loadings are discussed earlier in this chapter.

4.3.5 Boot Strapping Validation

Bootstrap is a popular method for validating statistical findings and is a method for deriving robust estimates of standard errors and confidence intervals for estimates. Bootstrap can also be used for constructing hypothesis tests. Bootstrap is a re-sampling method whereby "multiple sub-samples of the same size as the original sample are drawn randomly to provide data for empirical investigation of the variability of parameter estimates and indices of fit" (Byrne 2010). Random samples (potentially thousands) of the dataset are produced, "statistical analyses are run on each random sample, and a 95% bootstrap confidence interval for the primary finding is generated" (Byrne 2010) . If the bootstrap confidence intervals are relatively narrow, then researchers can assume that the findings are valid. The bootstrap validation technique was used in this research study with SPSS Version 25.

Given the small sample size of of this study, which was less than the recommended 200, by "larger for SEM models has been advocated" (Boomsma 1983; Kline 2011) and "the main test

of model fit (χ^2 goodness-of-fit) is sample size dependent and performs optimally in a range of at least 200–400" (Kenny 2012). In SEM, however, "a simple model with a small sample could still hold potential benefits to a researcher without the ability to attain 200 observations" (Kenny 2012). Thus, given the sample in this reseach was 148 participants, bootstrap sampling was used in this study to expand the sample to explore the model and also to check the existence of multivariate non-normal data.

In order to test relationships between the obtained factors, structural equation modelling was performed using AMOS. The path analysis used bootstrapped testing with a 95% bias corrected confidence interval, and 2,000 bootstrapped samples, to test for mediation (indirect) effects. While the error covariances were numerous, this was is likely reflective of the low sample size used in analysis. Following the deletion of the low weighted Proactive Care item, and the addition of the aforementioned covariances, the model had an overall acceptable fit. As such, path analysis was undertaken. The results for this are presented earlier in thid chapter.

Table 4.9 The goodness of fit for the structural model

	CFA 1	CFA with modifications	Path model	Thresholds*
CMIN/DF	1.913	1.610	1.568	< 3
CFI	0.863	0.914	0.914	> 0.90/95
TLI	0.852	0.905	0.906	> 0.90/95
RMSEA	0.084	0.069	0.066	< 0.08

Note: χ2/df = normed chi-square statistic; GFI = Goodness-of-Fit Index;
RMR= Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation;
NFI = Normed Fit Index; TLI = Tucker-Lewis Index; CFI = Comparative Fit Index.
*Sources: Hoyle (2000); Hu and Bentler (2010); Kline (2005); Thompson (2005).

4.4 Multicollinearity

A multicollinearity analysis was done for the study using a variance inflation analysis (VIF) the results of which are in the table below:

Table 4.10 VIF for Multicollnearity

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-1.138	1.052		-1.081	0.282					
well_being_1_1	Overall, I am reasonably happy with my work life	0.023	0.114	0.019	0.199	0.843	0.555	0.021	0.010	0.263	3.795
well_being_2_1	Overall, I fulfil an important purpose in the work that I do	-0.182	0.145	-0.095	-1.252	0.214	0.186	-0.129	-0.060	0.400	2.500
well_being_3_1	Most days I feel a sense of accomplishment from my work	0.172	0.135	0.100	1.274	0.206	0.293	0.131	0.061	0.369	2.712
Proactive_care_1_1	I am able to recognise health problems in the residents that I care for	0.219	0.167	0.105	1.306	0.195	0.019	0.134	0.063	0.355	2.820
Proactive_care_2_1	I closely monitor any changes in the physical weight of residents	0.000	0.139	0.000	0.004	0.997	0.066	0.000	0.000	0.426	2.346
Proactive_care_3_1	I know what to do when I suspect a resident has a pressure injury	0.236	0.192	0.096	1.231	0.222	0.016	0.127	0.059	0.375	2.667
Proactive_care_4_1	I can generally identify who is likely to get a pressure injury and monitor them accordingly	-0.399	0.240	-0.180	-1.665	0.099	0.135	-0.170	-0.080	0.197	5.077
Proactive_care_5_1	I am good at preventing injuries or infection in residents	0.006	0.168	0.003	0.036	0.971	0.072	0.004	0.002	0.435	2.301
affect_com_1_1	This organisation has a great deal of personal meaning for me	0.185	0.081	0.217	2.282	0.025	0.538	0.230	0.109	0.254	3.935
affect_com_2_1	I would be happy to spend the rest of my career with this organisation	0.037	0.099	0.039	0.377	0.707	0.581	0.039	0.018	0.212	4.718
affect_com_3_1	I enjoy discussing my organisation with people outside it	-0.068	0.075	-0.073	-0.904	0.368	0.412	-0.093	-0.043	0.352	2.843

affect_com_4_1	I feel emotionally attached to this organisation	-0.099	0.120	-0.108	-0.824	0.412	0.569	-0.085	-0.039	0.134	7.439
affect_com_5_1	I feel a strong sense of belonging to this organisation	-0.006	0.133	-0.006	-0.042	0.967	0.494	-0.004	-0.002	0.103	9.675
affect_com_6_1	I feel strong ties to this organisation	0.126	0.142	0.143	0.887	0.377	0.561	0.092	0.042	0.088	11.348
POS_1_1	cares about my opinion	0.208	0.133	0.199	1.562	0.122	0.555	0.160	0.075	0.142	7.061
POS_2_1	cares about my wellbeing	-0.102	0.140	-0.099	-0.724	0.471	0.529	-0.075	-0.035	0.123	8.140
POS_3_1	considers my goals and values	-0.068	0.123	-0.063	-0.552	0.583	0.469	-0.057	-0.026	0.176	5.692
POS_4_1	provides help for me when I have a problem	0.069	0.108	0.056	0.641	0.523	0.528	0.066	0.031	0.298	3.352
POS_5_1	would forgive an honest mistake on my part	-0.104	0.082	-0.095	-1.264	0.209	0.389	-0.130	-0.060	0.405	2.469
POS_6_1	would not take advantage of me	0.085	0.093	0.083	0.915	0.363	0.550	0.094	0.044	0.277	3.606
POS_7_1	is willing to help me if I need a special favour	0.043	0.089	0.043	0.484	0.629	0.497	0.050	0.023	0.288	3.470
a1	It is easy to use digital technology in my work	-0.081	0.117	-0.059	-0.694	0.489	0.439	-0.072	-0.033	0.318	3.147
a2	I can effectively complete my work using the available digital technology	0.329	0.128	0.225	2.574	0.012	0.517	0.258	0.123	0.299	3.344
a5	Whenever I make a mistake using the technology I can recover quickly and easily	0.045	0.118	0.028	0.381	0.704	0.354	0.040	0.018	0.427	2.344
a7	Using digital technology makes me feel like I am always on the job	-0.083	0.086	-0.075	-0.962	0.339	0.397	-0.099	-0.046	0.374	2.671
a8	Using digital technology reduces my fatigue level at work	0.025	0.088	0.025	0.280	0.780	0.490	0.029	0.013	0.278	3.598
a9	The digital technology at my organisation reduces the amount of bureaucratic red tape and administration work	-0.010	0.104	-0.010	-0.097	0.923	0.534	-0.010	-0.005	0.225	4.435
a10	Digital technology helps me get my work done during staff shortages	0.072	0.096	0.077	0.751	0.454	0.526	0.078	0.036	0.216	4.619
a11	Using digital technology makes me feel more satisfied with my work	-0.282	0.117	-0.290	-2.415	0.018	0.468	-0.243	-0.116	0.159	6.283
a12	Digital technology makes me feel very connected to the people in my organisation	0.129	0.119	0.136	1.076	0.285	0.636	0.111	0.052	0.143	6.993
a13	Using digital technology helps me identify problems at work and work to resolve them	0.235	0.122	0.231	1.920	0.058	0.640	0.195	0.092	0.159	6.295

a14	Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors	0.039	0.112	0.038	0.347	0.730	0.554	0.036	0.017	0.196	5.113
a15	Digital technology helps me listen to residents' complaints or wishes and respond/cope appropriately	0.074	0.111	0.077	0.669	0.505	0.594	0.069	0.032	0.173	5.793
a16	Digital technology helps to remind me that my work is meaningful and purposeful	-0.079	0.126	-0.077	-0.633	0.528	0.569	-0.065	-0.030	0.155	6.471
a17	We have meetings to discuss ways we can innovate and use technology better	0.169	0.120	0.167	1.403	0.164	0.631	0.144	0.067	0.162	6.172
a18	Digital technology helps me get my work done during staff shortages	0.313	0.086	0.315	3.665	0.000	0.721	0.355	0.175	0.311	3.216

a. Dependent Variable: a20

4.5 Multivariate Normality

A multivariate normality analysis was done for this study, for which the results are displayed in the following table.

Table 4.11 Multivariate normality results

Variable		min	max	skew	c.r.	kurtosis	c.r.
POS_7_1	is willing to help me if I need a special favour	1	6	-0.658	-3.061	-0.251	-0.584
POS_6_1	would not take advantage of me	1	6	-0.697	-3.244	-0.093	-0.215
POS_5_1	would forgive an honest mistake on my part	1	6	-0.764	-3.557	-0.018	-0.041
POS_4_1	provides help for me when I have a problem	1	6	-0.85	-3.956	0.926	2.156
POS_3_1	considers my goals and values	1	6	-0.624	-2.906	0.058	0.134
POS_2_1	cares about my wellbeing	1	6	-0.874	-4.068	0.308	0.716
POS_1_1	cares about my opinion	1	6	-0.739	-3.438	0.115	0.268
well_being_3_1	Most days I feel a sense of accomplishment from my work	3	6	-0.563	-2.623	0.306	0.712
well_being_1_1	Overall, I am reasonably happy with my work life	1	6	-0.968	-4.504	0.75	1.746
well_being_2_1	Overall, I fulfil an important purpose in the work that I do	3	6	-0.717	-3.336	1.328	3.091
a5	Whenever I make a mistake using the technology I can recover quickly and easily	2	6	-0.613	-2.854	0.916	2.131
a1	It is easy to use digital technology in my work	2	6	-0.896	-4.17	1.05	2.443
a2	I can effectively complete my work using the available digital technology	2	6	-1.006	-4.681	1.507	3.507
Proactive_care_2_1	I closely monitor any changes in the physical weight of residents	3	6	-0.525	-2.442	0.61	1.42
Proactive_care_1_1	I am able to recognise health problems in the residents that I care for	4	6	-0.157	-0.729	-0.552	-1.285
Proactive_care_5_1	I am good at preventing injuries or infection in residents	4	6	0.021	0.098	-0.219	-0.509
Proactive_care_3_1	I know what to do when I suspect a resident has a pressure injury	4	6	0.095	0.443	-1.001	-2.331
Proactive_care_4_1	I can generally identify who is likely to get a pressure injury and monitor them accordingly	4	6	-0.13	-0.607	-0.541	-1.258
affect_com_3_1	I enjoy discussing my organisation with people outside it	1	6	-0.197	-0.917	-1.064	-2.477
affect_com_1_1	This organisation has a great deal of personal meaning for me	1	6	-0.469	-2.183	-0.762	-1.774

affect_com_2_1	I would be happy to spend the rest of my career with this organisation	1	6	-0.643	-2.993	-0.28	-0.651
affect_com_4_1	I feel emotionally attached to this organisation	1	6	-0.542	-2.521	-0.676	-1.572
affect_com_5_1	I feel a strong sense of belonging to this organisation	1	6	-0.757	-3.524	-0.454	-1.057
affect_com_6_1	I feel strong ties to this organisation	1	6	-0.601	-2.799	-0.81	-1.885
a18	We have meetings to discuss ways we can innovate and use technology better	1	6	-0.541	-2.516	-0.756	-1.76
a7	Using digital technology makes me feel like I am always on the job	1	6	-0.406	-1.889	-0.588	-1.369
a8	Using digital technology reduces my fatigue level at work	1	6	-0.235	-1.095	-0.911	-2.121
a12	Digital technology makes me feel very connected to the people in my organisation	1	6	-0.41	-1.909	-1.028	-2.394
a9	The digital technology at my organisation reduces the amount of bureaucratic red tape and administration work	1	6	-0.441	-2.053	-0.714	-1.661
a10	Digital technology helps me get my work done during staff shortages	1	6	-0.141	-0.658	-1.196	-2.784
a14	Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors	1	6	-0.612	-2.847	-0.573	-1.335
a11	Using digital technology makes me feel more satisfied with my work	1	6	-0.649	-3.021	-0.723	-1.682
a15	Digital technology helps me listen to residents' complaints or wishes and respond/cope appropriately	1	6	-0.492	-2.292	-0.995	-2.315
a17	Digital technology helps to remind me that my work is meaningful and purposeful	1	6	-0.611	-2.845	-0.573	-1.333
a13	Using digital technology helps me identify problems at work and work to resolve them	1	6	-0.801	-3.727	-0.213	-0.496
a16	Digital technology helps me decide how to care for residents according to my own judgment as a carer	1	6	-0.693	-3.226	-0.631	-1.468
Multivariate						187.821	20.47

4.5.1 Justification of using SEM instead of Mutiple Regression

SEM is a "method of multivariate statistical analysis capable of measuring the underlying latent constructs identified by factor analysis and assessing the paths of the hypothesized relationships between the constructs" (Klem 2000). According to Hair et al. (1998), "SEM has two main advantages: first 'SEM allow for the estimation of a series, but independent, multiple regression equations simultaneously", secondly SEM "has the ability to incorporate latent

variables into the analysis and accounts for measurement errors in the estimation process" (Hair et al. 1998). SEM is a statistical technique that establishes measurement models and structural models to address complicated behavioral relationships. Complicated behavioural models are a feature of positive computing, compared to multiple regression, which is suitable for evaluating constructs and the relationships between constructs. Given the explanatory nature of this research and the lack of quantitative research in positive computing the more flexible assumptuions of SEM relative to the stricter or more rigid assumptions of regression analysis made SEM more suiable for this research.

4.5.2 Descriptive analysis of measurement items

In order to better understand the items used in this study, descriptive analysis of all used items is presented in the next five subsections. Respondents were asked to specify the degree to which they agreed or disagreed with a list of 29 statements on a six-point Likert scale. Table 4.12 below shows how scale levels are interpreted.

Table 4.12 Interpretation of six-point Likert scale values

Mean Value	Meaning
1 to 1.49	Strongly disagree
1.50 to 2.49	Disagree
2.50 to 3.49	Slightly disagree
3.50 to 4.49	Slightly agree
4.50 to 5.49	Agree
5.50 to 6.00	Strongly agree

In order to calculate the relative importance of each item in the factor, category length was calculated using the equation below:

$$\textit{Category length} = \textit{(upper limit} - \textit{lower limit)} / \textit{the number of levels}$$

As category length was 1.66 ((6 – 1) / 3), three levels were created. A low level of importance was 1.00–2.66, a medium level of importance was 2.67–4.33 and a high level of importance was 4.34–6.00.

The positive computing factor is a second order factor made up of positive computing care and positive computing capability.

4.5.2.1 Positive computing care factor

The first factor consists of 12 items, and descriptive analysis with corresponding EFA and CFA loadings is presented in Table 4.13.

Table 4.13 Positive computing care factor

Item	Mean	Standard Deviation
Digital technology helps them decide how to care for residents according to their own judgment as a carer	3.95	1.26
Using digital technology helps them identify problems at work and work to resolve them	4.16	1.27
Digital technology helps to remind them that their work is meaningful and purposeful	3.96	1.28
Digital technology helps them listen to residents' complaints or wishes and respond appropriately	3.88	1.35
Using digital technology makes them feel more satisfied with work	3.98	1.33
Using digital technology enables them to make judgments on their own work and perform tasks without instructions from superiors	4.02	1.25
Digital technology helps them get their work done during staff shortages	3.53	1.39
Digital technology at their organisation reduces the amount of bureaucratic red tape and administration work	3.96	1.26
Digital technology makes them feel very connected to the people in their organisation	3.83	1.38
Using digital technology reduces their fatigue level at work	4.05	1.34
Using digital technology makes them feel like they are always on the job	4.08	1.18
They have meetings to discuss ways they can innovate and use technology better	3.74	1.30
They can effectively complete their work using the available digital technology	4.81	0.89
It is easy to use digital technology in their work	4.75	0.94
Whenever they make a mistake using the technology they can recover quickly and easily	4.72	0.81

Note: Maximum possible score was 6.

On the individual importance of used items, all 12 items rated as having medium importance. The item "using digital technology helps me identify problems at work and work to resolve them" had the highest value (Mean = 4.16; SD = 1.27) and the item "digital technology helps me get my work done during staff shortages" had the lowest value (Mean = 3.53; SD = 1.39) in this particular factor.

As Kline (2011) indicated, there is a "convergent validity of a particular factor when all indicators specified to measure a common factor have relatively high standardised factor loadings on that factor" (e.g., above 0.7). Table 4.14 shows that factor loadings of items that load on the positive computing care factor have sufficiently high factor loadings (ranging from 0.66 to 0.97, 0.79 on average), which are above the recommended value.

The reliability of the factor was also checked with Cronbach's alpha coefficient calculation. The positive computing care factor had a high reliability of used items, with Cronbach's alpha of 0.957, which is above the recommended value of 0.7 (Pallant 2011).

Table 4.14 Positive computing care factor: EFA and CFA loadings, descriptives and Cronbach's alpha

Items	EFA loadings	CFA loadings	Mean	SD	Relative importance	Rank	Cronbach's alpha
Digital technology helps me decide how to care for residents according to my own judgment as a carer	0.890	0.840	3.95	1.26	Medium	8	
Using digital technology helps me identify problems at work and work to resolve them	0.822	0.846	4.16	1.27	Medium	1	
Digital technology helps to remind me that my work is meaningful and purposeful	0.848	0.880	3.96	1.28	Medium	6	
Digital technology helps me listen to residents' complaints or wishes and respond/cope appropriately	0.792	0.801	3.88	1.35	Medium	9	
Using digital technology makes me feel more satisfied with my work	0.978	0.860	3.98	1.33	Medium	5	
Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors	0.791	0.772	4.02	1.25	Medium	4	.957
Digital technology helps me get my work done during staff shortages	0.845	0.825	3.53	1.39	Medium	12	
The digital technology at my organisation reduces the amount of bureaucratic red tape and administration work	0.789	0.815	3.96	1.26	Medium	6	
Digital technology makes me feel very connected to the people in my organisation	0.804	0.875	3.83	1.38	Medium	10	
Using digital technology reduces my fatigue level at work	0.775	0.752	4.05	1.34	Medium	3	
Using digital technology makes me feel like I am always on the job	0.641	0.651	4.08	1.18	Medium	2	
We have meetings to discuss ways we can innovate and use technology better	0.545	0.690	3.74	1.30	Medium	11	

4.5.2.2 Positive computing capability factor

The second factor consists of three items, and descriptive analysis with corresponding EFA and CFA loadings is presented in Table 4.15. The mean values suggest that respondents agree on all three items: they "can effectively complete their work using the available digital technology" (Mean = 4.81; SD = 0.89), "it is easy to use digital technology in their work" (Mean = 4.75; SD = 0.94) and "whenever they make a mistake using the technology they can recover quickly and easily" (Mean = 4.72; SD = 0.81).

All three items have individual high importance. The item "I can effectively complete my work using the available digital technology" had the highest value (Mean = 4.81; SD = 0.89) and the item "whenever I make a mistake using the technology I can recover quickly and easily" had the lowest value (Mean = 4.72; SD = 0.81) in this particular factor.

As Kline (2011) indicated, there is a "convergent validity of a particular factor when all indicators specified to measure a common factor have relatively high standardised factor loadings on that factor" (e.g., above 0.7). Table 4.15 shows that factor loadings of items that load on the positive computing capability factor have sufficiently high factor loadings (ranging from 0.60 to 0.88, 0.76 on average), which is above the recommended value.

The reliability of the factor was checked with Cronbach's alpha coefficient calculation. The positive computing capability factor has high reliability of used items, as Cronbach's alpha was 0.81, above the recommended value of 0.7 (Pallant 2011).

Hair et al. (2010) and MacKenzie et al. (2011) state that factor loadings should be statistically significant and at least 0.5, the value of AVE indicators should be above 0.5, and CR should be above 0.7 if convergent validity of used constructs exists. Considering that the second order factor (positive computing) was introduced, consisting of the factors positive computing care and positive computing capability, the value of AVE was calculated for the second order factor and it was above the recommended value of 0.5 (AVE = 0.57) while the value of CR was above 0.7 (CR = 0.72). Accordingly, it can be concluded that convergent validity of the factor was achieved.

Table 4.15 Positive computing capability factor: EFA and CFA loadings, descriptives and Cronbach's alpha

Items	EFA loadings	CFA loadings	Mean	SD	Relative importance	Rank	Cronbach's alpha
I can effectively complete my work using the available digital technology	0.737	0.867	4.81	0.89	High	1	
It is easy to use digital technology in my work	0.845	0.821	4.75	0.94	High	2	.805
Whenever I make a mistake using the technology I can recover quickly and easily	0.571	0.616	4.72	0.81	High	3	

4.5.2.3 Affective commitment factor

The third factor consists of six items, and descriptive analysis with corresponding EFA and CFA loadings is presented in Table 4.16. The mean values suggest that respondents somewhat agree on all six items: they feel strong ties with this organisation (Mean = 3.78; SD = 1.47), they "feel a strong sense of belonging to this organisation" (Mean = 3.90; SD = 1.45), they "feel emotionally attached to this organisation" (Mean = 3.72; SD = 1.41), "this organisation has a great deal of personal meaning for them" (Mean = 3.98; SD = 1.36), "they would be very happy to spend the rest of their career with this organisation" (Mean = 3.85; SD = 1.52), and "they enjoy discussing their organisation with people outside it" (Mean = 3.48; SD = 1.40).

Of the six items, all have medium importance, while the item "this organisation has a great deal of personal meaning for me" had the highest value (Mean = 3.98; SD = 1.36) and the item "I enjoy discussing my organisation with people outside it" had the lowest value (Mean = 3.48; SD = 1.40) in this particular factor.

As Kline (2011) indicates, there is a convergent validity of a particular factor when "all indicators specified to measure a common factor have relatively high standardised factor loadings on that factor" (e.g. above 0.7). Table 4.16 below shows that factor loadings of items that load on the affective commitment factor have sufficiently high factor loadings (ranging from 0.69 to 0.96, 0.85 on average), above the recommended value.

Besides the criteria that factor loadings should be above 0.5, two other criteria recommended by Hair et al. (2010) and MacKenzie et al. (2011) were fulfilled. The calculated value of AVE was above 0.5 (AVE = 0.73) and the value of CR was above 0.7 (CR = 0.94). Accordingly, it can be concluded that convergent validity of the affective commitment factor was achieved.

The reliability of the factor was checked with Cronbach's alpha coefficient calculation. The affective commitment factor has high reliability of used items, as Cronbach's alpha was 0.94 which is above the recommended value of 0.7 (Pallant 2011).

Table 4.16 Affective commitment factor: EFA and CFA loadings, descriptives and Cronbach's alpha

Items	EFA loadings	CFA loadings	Mean	SD	Relative importance	Rank	Cronbach's alpha
I feel strong ties with this organisation	0.963	0.962	3.78	1.47	Medium	4	
I feel a strong sense of belonging to this organisation	0.957	0.944	3.90	1.45	Medium	2	
I feel emotionally attached to this organisation	0.920	0.915	3.72	1.41	Medium	5	
This organisation has a great deal of personal meaning for me	0.760	0.825	3.98	1.36	Medium	1	.938
I would be very happy to spend the rest of my career with this organisation	0.812	0.739	3.85	1.52	Medium	3	
I enjoy discussing my organisation with people outside it	0.715	0.700	3.48	1.40	Medium	6	

4.5.2.4 Proactive care factor

The fourth factor consists of five items, and descriptive analysis with corresponding EFA and CFA loadings is presented in Table 4.17. The mean values suggest that respondents agree on all five items: they can generally "identify who is likely to get a pressure injury, and monitor them accordingly" (Mean = 5.28; SD = 0.58), they know "what to do when they suspect a resident has a pressure injury" (Mean = 5.36; SD = 0.53), they are "good at preventing injuries or infection in residents" (Mean = 5.20; SD = 0.56), they are able to "recognise health problems in the residents that they care for" (Mean = 5.19; SD = 0.62) and they "closely monitor any changes in the physical weight of residents" (Mean = 5.07; SD = 0.68).

All the individual items have medium importance. The item "I know what to do when I suspect a resident has a pressure injury" had the highest value (Mean = 5.36; SD = 0.53) and the item "I closely monitor any changes in the physical weight of residents" had the lowest value (Mean = 5.07; SD = 0.68) in this particular factor.

Table 4.17 shows that factor loadings of items that load on the proactive care factor have high factor loadings (ranging from 0.49 to 0.96, 0.69 on average), which is slightly below the recommended value. Hair et al. (2010) and MacKenzie et al. (2011) suggest that factor loadings should be statistically significant and at least 0.5, the value of AVE indicators should be above 0.5, and CR should be above 0.7 if convergent validity of used constructs exists. Although one

item has a factor loading below 0.5, the calculated value of AVE was above 0.5 (AVE = 0.51) and the value of CR was above 0.7 (CR = 0.83). Accordingly, it can be concluded that convergent validity of the proactive care factor was achieved. The reliability of particular factors was evaluated by Cronbach's alpha coefficient. The proactive care factor has a high reliability of used items, as Cronbach's alpha was 0.831 which is above the recommended value of 0.7 (Pallant 2011).

Table 4.17 Proactive care factor: EFA and CFA loadings, descriptives and Cronbach's alpha

Items	EFA loadings	CFA loadings	Mean	SD	Relative importance	Rank	Cronbach's alpha
I can generally identify who is likely to get a pressure injury, and monitor them accordingly	0.885	1.001	5.28	0.58	High	2	.831
I know what to do when I suspect a resident has a pressure injury	0.758	0.702	5.36	0.53	High	1	
I am good at preventing injuries or infection in residents	0.703	0.679	5.20	0.56	High	3	
I am able to recognise health problems in the residents that I care for	0.661	0.575	5.19	0.62	High	4	

4.5.2.5 Wellbeing factor

The fifth factor consists of three items, and descriptive analysis with corresponding EFA and CFA loadings is presented in Table 4.18w. The mean values suggest that respondents agree on all three items: they "fulfil an important purpose in the work that they do" (Mean = 5.09; SD = 0.68), "they are reasonably happy with their work life" (Mean = 4.52; SD = 1.07) and "most days they feel a sense of accomplishment from their work" (Mean = 4.89; SD = 0.76).

All the individual items have a high importance. The item "Overall, I fulfil an important purpose in the work that I do" had the highest value (Mean = 5.09; SD = 0.68) and the item "Overall, I am reasonably happy with my work life" had the lowest value (Mean = 4.52; SD = 1.07) in this wellbeing factor.

As Kline (2011) indicated, there is a convergent validity of a particular factor "when all indicators specified to measure a common factor have relatively high standardised factor loadings on that factor" (e.g. above 0.7). Table 4.18 below shows that the factor loadings of items that load on the wellbeing factor have sufficiently high factor loadings slightly below the recommended value (0.67 on average). Besides the criteria that factor loadings should be above 0.5, two other criteria recommended by Hair et al. (2010) and MacKenzie et al. (2011) were fulfilled. The calculated value of AVE was above 0.5 (AVE = 0.52) and the value of CR was

above 0.7 (CR = 0.74). Accordingly, it can be concluded that convergent validity of the wellbeing factor was achieved.

The reliability of the factor was assessed by calculation of the Cronbach's alpha coefficient. The wellbeing factor has high reliability of used items, as Cronbach's alpha was 0.75, which is above the recommended value of 0.7 (Pallant 2011).

Table 4.18 Wellbeing factor: EFA and CFA loadings, descriptives and Cronbach's alpha

Items	EFA loadings	CFA loadings	Mean	SD	Relative importance	Rank	Cronbach's alpha
Overall, I fulfill an important purpose in the work that I do	0.288	0.501	5.09	0.68	High	1	.756
Overall, I am reasonably happy with my work life	0.564	1.058	4.52	1.07	High	3	
Most days I feel a sense of accomplishment from my work	0.456	0.457	4.89	0.76	High	2	

4.5.2.6 Perceived organisational support factor

The sixth factor consists of seven items, and descriptive analysis with corresponding EFA and CFA loadings is presented in Table 4.19. The mean values suggest that respondents slightly agree on all seven items: "the organisation cares about my opinion" (Mean = 4.21; SD = 1.24), "cares about my wellbeing" (Mean = 4.38; SD = 1.26), "considers my goals and values" (Mean = 4.17; SD = 1.20), "provides help for me when I have a problem" (Mean = 4.42; SD = 1.05), "would forgive an honest mistake on my part" (Mean = 4.21; SD = 1.19), "would not take advantage of me" (Mean = 4.18; SD = 1.27) and is "willing to help me if I need a special favour" (Mean = 4.02; SD = 1.31).

All but two individual items have medium importance. The item "provides help when I have a problem" had the highest value (Mean = 4.42; SD = 1.05) and the item "willing to help me if I need a special favour" had the lowest value (Mean = 4.02; SD = 1.31) in this particular factor.

Table 4.19 shows that factor loadings of items that load on the perceived organisational support factor have high factor loadings (ranging from 0.58 to 0.93, 0.78 on average), which is above the recommended value. Hair et al. (2010) and MacKenzie et al. (2011) suggest that factor loadings should be statistically significant and at least 0.5, the value of AVE indicators should be above 0.5, and CR should be above 0.7 if convergent validity of used constructs exists. Considering that the calculated value of AVE was above 0.5 (AVE = 0.63) and the value of CR was above 0.7 (CR = 0.92), it can be concluded that convergent validity of the perceived

organisational support factor was achieved. The reliability of the factor was evaluated by Cronbach's alpha coefficient. The perceived organisational support factor has a high reliability of used items, as Cronbach's alpha was 0.92 which is above the recommended value of 0.7 (Pallant 2011).

Table 4.19 Perceived organisational support factor: EFA and CFA loadings, descriptives and Cronbach's alpha

Items	EFA loadings	CFA loadings	Mean	SD	Relative importance	Rank	Cronbach's alpha
They care about my opinion	0.908	0.929	4.21	1.243	Medium	3	
They care about my wellbeing	0.907	0.937	4.38	1.265	High	2	
They consider my goals and values	0.883	0.882	4.17	1.202	Medium	5	
They provide help for me when I have a problem	0.804	0.769	4.42	1.055	High	1	.922
They would forgive an honest mistake on my part	0.599	0.559	4.21	1.192	Medium	3	
They would not take advantage of me	0.643	0.704	4.18	1.273	Medium	4	
They are willing to help me if I need a special favour	0.721	0.663	4.02	1.306	Medium	6	

4.5.3 Proposed structural model

In order to test relationships between the obtained factors, structural equation modelling was performed using AMOS. The path analysis used bootstrapped testing with a 95% bias corrected confidence interval, and 2,000 bootstrapped samples, to test for mediation (indirect) effects. The model was developed with four endogenous (dependent) constructs (positive computing, proactive care, affective commitment and carer wellbeing) and one exogenous (independent) construct (perceived organisational support). The proposed model was created in the way that perceived organisational support has a direct and positive impact on positive computing, as well as having a direct and positive impact on proactive care, affective commitment and carer wellbeing. Further, positive computing has a direct and positive impact on proactive care, affective commitment and carer wellbeing while carer wellbeing has a direct and positive impact on affective commitment and proactive care. Finally, affective commitment has an impact on proactive care. Also, wellbeing mediates the relationships between positive computing and affective commitment, as well as the relationships between positive computing and proactive care. Affective commitment mediates the relationships between positive computing and proactive care. The model is shown in Figure 4.2 below and achieved a good fit, as summarised in Table 4.20.

Figure 4.2 Structural equation model

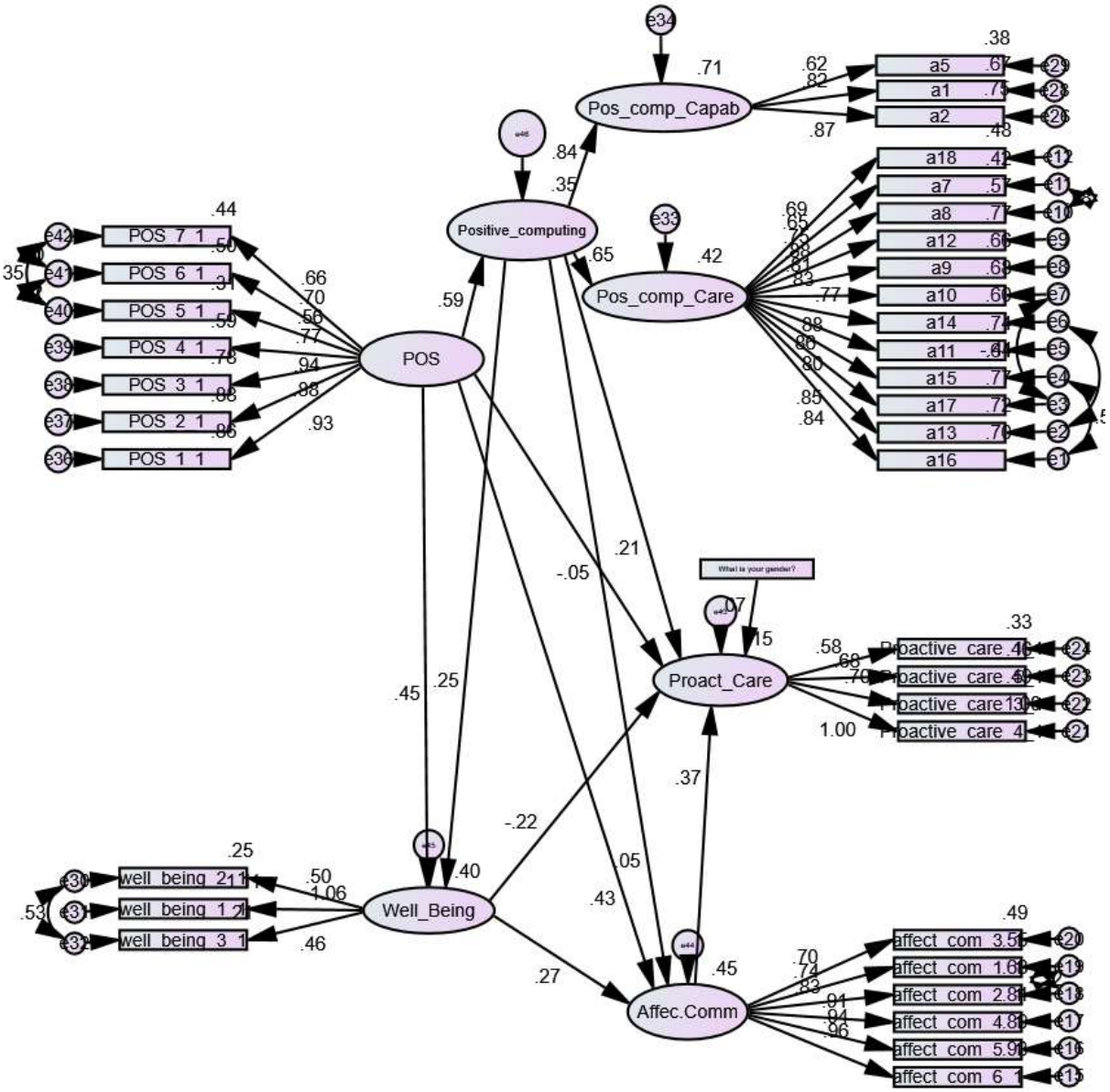
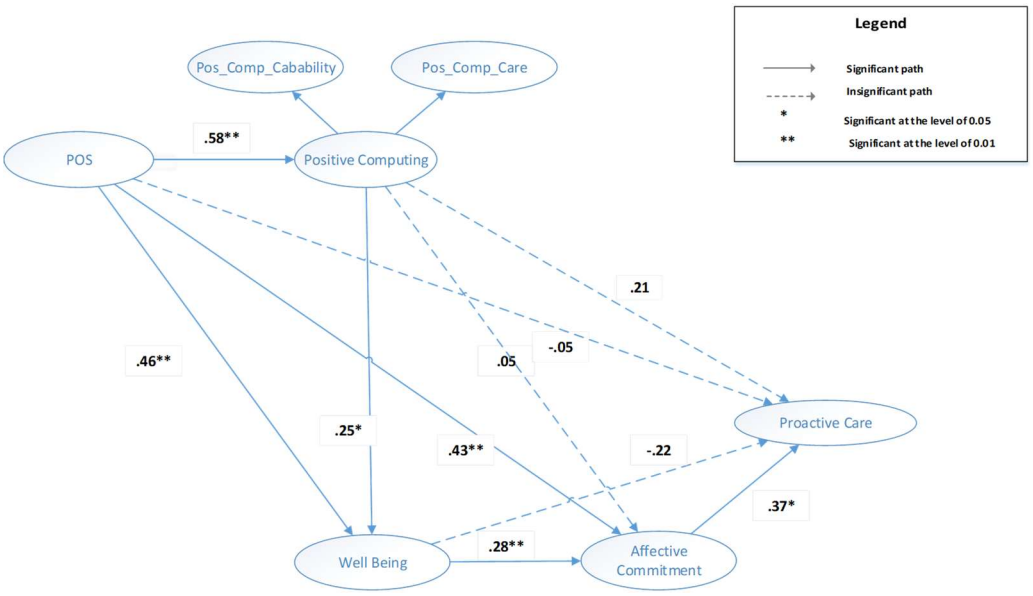


Table 4.20 The goodness of fit for the structural model

	CFA 1	CFA with modifications	Path model	Thresholds*
CMIN/DF	1.913	1.610	1.568	< 3
CFI	0.863	0.914	0.914	> 0.90/95
TLI	0.852	0.905	0.906	> 0.90/95
RMSEA	0.084	0.069	0.066	< 0.08

Note: $\chi 2/df$ = normed chi-square statistic; GFI = Goodness-of-Fit Index;
RMR= Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation;
NFI = Normed Fit Index; TLI = Tucker-Lewis Index; CFI = Comparative Fit Index.
*Sources: Hoyle (2000); Hu and Bentler (2010); Kline (2005); Thompson (2005).

Figure 4.3 Structural equation model



After testing the overall model fit, the structural relationships between latent constructs were tested for significance and results are in Table 4.21. Perceived organisational support was positively associated with positive computing ($\beta = 0.58$, $p < 0.01$), explaining 35% of the variance of positive computing. Perceived organisational support was also positively associated with employee wellbeing and affective commitment, however it was not directly associated with proactive care. There was evidence of full mediation (indirect effect) between perceived organisational support and proactive care, with this occurring through affective commitment which was the only construct with a direct, significant effect on proactive care.

Positive computing was positively associated with employee wellbeing ($\beta = 0.25$, $p < 0.5$) and perceived organisational support and positive computing explained 40% of the variance of

employee wellbeing. This supports the hypothesis that positive computing has a small, but notable positive impact on employee wellbeing.

Positive computing had a small, indirect effect on affective commitment ($\beta = 0.12$, $p < 0.5$), with wellbeing mediating the relationship. In essence, this means that positive computing has the potential to boost wellbeing, and this contributes positively to affective commitment.

Positive computing did not have a significant relationship on proactive care. These results indicate that positive computing can have benefits for the aged care workforce (namely, wellbeing and commitment), however it does not significantly impact the level of proactive care.

Employee wellbeing was associated with higher levels of affective commitment ($\beta = 0.28$, $p < 0.01$) and perceived organisational support, positive computing and wellbeing explained 45% of the variance of affective commitment. Affective commitment had a moderate, positive association with proactive care ($\beta = 0.37$, $p < 0.05$).

Taken together, these results suggest that aged care facilities that put in place a supportive, social exchange culture (i.e. those that have high perceived organisational support) are more likely to put in place technological practices that are commensurate with positive computing. In such settings, positive computing has the ability to advance employee wellbeing and affective commitment, however it was not significantly associated with a higher quality of proactive care.

Table 4.21 Standardised direct, indirect and total effects

Path	Direct	Indirect	Total	Evidence of
POS -> Positive Computing	.58**	-	.58**	Direct effect
POS -> Wellbeing	.46**	.14*	.60**	Partial mediation
POS -> Affective Commitment	.43**	.51 N.S.	.63**	Direct effect
POS -> Proactive Care	-.05 N.S.	.22*	.22*	Full mediation
Positive Computing -> Wellbeing	.25*	-	.25*	Direct effect
Positive Computing -> Affective Commitment	.05 N.S.	.12*	.12*	Full mediation (via wellbeing)
Positive Computing -> Proactive Care	.21 N.S.	.00 N.S.	.21 N.S.	Not significant path
Wellbeing -> Affective Commitment	.28**	-	.28**	Direct effect
Wellbeing -> Proactive Care	-.22 N.S.	.10 N.S.	-.12 N.S.	Not significant path
Affective Commitment -> Proactive Care	.37*	-	.37*	Direct effect
Gender -> Proactive Care	.07 N.S		.7 N.S.	Not significant path

*** p<0.001, ** p<0.01, * p<0.05, ^ p<0.1. n = 136. The ^ symbol has been used to represent marginal or 'approaching significance' owing to the small sample size; N.S. = non-significant.

4.6 Discussion

This section discusses the analysis of the data. It also lists the key findings and identifies some of the limitations of the research and how they might be addressed in future.

4.6.1 Key findings

Perceived organisational support was positively associated with positive computing ($\beta = 0.58$, $p < 0.001$), explaining 35% of the variance of positive computing. It was also positively associated with employee wellbeing and affective commitment, however it was not directly associated with proactive care. There was evidence of full mediation (indirect effect) between perceived organisational support and proactive care, with this occurring through affective commitment which was the only construct with a direct, significant effect on proactive care.

Positive computing was positively associated with employee wellbeing ($\beta = 0.25$, $p < 0.05$) and perceived organisational support, and positive computing explained 40% of the variance of employee wellbeing. This supports the hypothesis that positive computing has a small, but notable positive impact on employee wellbeing.

Positive computing had a small, indirect effect on affective commitment ($\beta = 0.12$, $p < 0.05$), with employee wellbeing mediating the relationship. In essence, this means that positive computing has the potential to boost employee wellbeing, and this contributes positively to affective commitment.

Positive computing did not have a significant relationship with proactive care. These results indicate that positive computing can have benefits for the aged care workforce (namely, wellbeing and commitment), however, it does not significantly impact the level of proactive care.

Employee wellbeing was associated with higher levels of affective commitment ($\beta = .028$, $p < 0.01$) and perceived organisational support, positive computing and employee wellbeing explained 45% of the variance of affective commitment. Affective commitment had a moderate, positive association with proactive care ($\beta = 0.37$, $p < 0.05$).

Taken together, these results suggest that aged care facilities that put in place a supportive, social exchange culture (i.e. those that have high perceived organisational support) are more

likely to put in place technological practices that are commensurate with positive computing. In such settings, positive computing has the ability to advance employee wellbeing and affective commitment, however it was not significantly associated with a higher quality of proactive care. This may be because positive computing does not drive efficiency outcomes, as in traditional technological innovation, but rather is driving human-centric outcomes. In aged care, where the physical and cognitive presence of the carer is of greater utility than the speed at which the carer undertakes tasks, positive computing seems to be driving the right outcomes of increased personal wellbeing for employees, and a desire to stay at the organisation – i.e. retention. Positive computing can play a part in the overall strategy mix that aged care organisations must develop to retain and attract care staff.

The literature review suggests this is the first study to collect data and measure the positive computing paradigm in the context of aged care. The results suggest that manifestation of positive computing can be measured in the context of aged care, including the assessment of effects on employee wellbeing.

The positive computing survey instrument can be used as a starting point to provide feedback to researchers, organisational leaders and workplace managers on how to progress further research that measures the effects and potential of positive computing, contributing to the research vision for the positive computing paradigm by Pawlowski et al. (2015).

4.6.2 Limitations of research

This study is an explanatory study and has some limitations. The first limitation is that the survey responses were limited to the perspectives of aged care workers from a single aged care organisation across its 11 facilities in Western Australia. One factor that determines how well results from quantitative research can be generalised to an entire population is the sample size. The analysis and findings of this research were drawn from a small sample size of 148 carers. The survey instrument was also small, with four or five questions for each construct. The instrument had 77 items and it took the aged care staff up to 30 minutes to complete the survey. As this took up most of their break time, a larger survey was not feasible due to time constraints. As it was also the first time a scale had been developed for positive computing in aged care, further research and testing is required to develop a more accurate and reliable scale.

As this data was collected at one aged care organisation its representativeness of other health care sectors and staff is unknown. Future research could address these limitations by increasing sample sizes and applying a larger survey instrument to workers in other industries and organisations.

4.7 Conclusion

This chapter reported the quantitative phase of the research to better understand the manifestation of positive computing in the aged care workforce by investigating the relationships between positive computing, perceived organisational support, affective commitment and carer wellbeing, and proactive care. In order to expand research in positive computing, interdisciplinary research that draws together positive psychology and information systems is needed (Pawlowski, Jansen & Koch 2015). This research needs to reconsider current information systems models, and could be broadened to include metrics that extend beyond ease of use and instead include both organisational performance and individual wellbeing (Pawlowski, Jansen & Koch 2015). This quantitative study contributed to the research request of Pawlowski, Jansen & Kock 2015. The next chapter presents and explains the findings from the qualitative phase of the research.

Chapter 5: Findings from the qualitative study

5.1 Overview

This chapter presents the findings from the second phase of the explanatory mixed methods research design. The quantitative study produced a number of findings that needed to be explored during the qualitative phase. Interviews were therefore conducted to collect qualitative data, which was used to explore, analyse and explain the findings from the quantitative study. Data was collected from interviews with 36 residential aged care workers at the aged care organisation in Western Australia, followed by a discussion of the themes revealed during the interviews. Section 5.2 summarises the findings from the quantitative analysis, Section 5.3 provides background to the qualitative data collection and Section 5.4 explores the themes identified during the quantitative phase and other themes that emerged from the analysis of the interviews. Section 5.4 concludes.

5.2 Summary of findings from quantitative analysis

5.2.1 Quantitative data collection

The results from the quantitative phase produced the following findings.

Perceived organisational support was positively associated with positive computing ($\beta = 0.58$, $p < 0.001$), explaining 35% of the variance of positive computing. It was also positively associated with employee wellbeing and affective commitment, however it was not directly associated with proactive care. There was evidence of full mediation (indirect effect) between perceived organisational support and proactive care, with this occurring through affective commitment which was the only construct with a direct, significant effect on proactive care.

Positive computing was positively associated with employee wellbeing ($\beta = 0.25$, $p < 0.05$) and perceived organisational support, and positive computing explained 40% of the variance of employee wellbeing. This supports the hypothesis that positive computing has a small, but notable positive impact on employee wellbeing.

Positive computing had a small, indirect effect on affective commitment ($\beta = 0.12$, $p < 0.05$), with wellbeing mediating the relationship. In essence, this means that positive computing has

the potential to boost employee wellbeing, and this contributes positively to affective commitment.

Positive computing did not have a significant relationship with proactive care. These results indicate that positive computing can have benefits for the aged care workforce (namely, wellbeing and commitment, however it does not significantly impact the level of proactive care.

Employee wellbeing was associated with higher levels of affective commitment ($\beta = 0.28$, $p < 0.01$) and perceived organisational support, positive computing and wellbeing explained 45% of the variance of affective commitment. Affective commitment had a moderate, positive association with proactive care ($\beta = 0.37$, $p < 0.05$).

Taken together, these results suggest that aged care facilities that put in place a supportive, social exchange culture (i.e. those that have high perceived organisational support), are more likely to put in place technological practices that are commensurate with positive computing. In such settings, positive computing has the ability to advance employee wellbeing and affective commitment, however it was not significantly associated with a higher quality of proactive care. This may be because positive computing does not drive efficiency outcomes, as in traditional technological innovation, but rather is driving human-centric outcomes. In aged care, where the physical and cognitive presence of the carer is of greater utility than the speed at which the carer undertakes tasks, positive computing seems to be driving the right outcomes of increased personal wellbeing for employees, and a desire to stay at the organisation – i.e. retention. Positive computing can play a part in the overall strategy mix that aged care organisations must develop to retain and attract care staff. The quantitative study produced a number of findings that needed to be explored during the qualitative phase.

Interviews were therefore conducted to collect qualitative data, which was used to explore, analyse and explain the findings from the quantitative study. As this is the first time that positive computing has been studied quantitatively (and in an aged care context) it is important that to validate the quantitative study during the qualitative study. According to Creswell (2009), a key objective of mixed methods research is to make the research outcomes more objective by neutralising any biases associated with a one method design. Creswell (2009) also suggests that combining qualitative and quantitative methods achieves better insights than using one without the other. Multimethod design with an explanatory Mixed methods research

phase is therefore suited to this study as aged care, positive computing and technology are very wide and complex fields of study further complicated by the number of stakeholders involved.

5.3 Background to qualitative phase data collection

The qualitative data was collected through 36 face-to-face semi-structured interviews with staff at the aged care organisation in Western Australia. Total interview time was approximately 18 hours, with an average of 28 minutes an interview. All interviewees were participants in the quantitative survey data collection. For the purposes of confidentiality, because the interviews were recorded, names and demographic details were not taken. Interviews were recorded and transcribed for analysis. The interviews were then entered into NVivo in a disassembly phase, during which the interviews were coded using a design to enable comparison and contrast of the results from the quantitative analysis with the results from the qualitative interviews.

The design in NVivo used the nodes outlined in Table 5.1 to search and find text from the qualitative interview transcripts that related to or contrasted with the quantitative data results. Several important issues emerged that were either brought up by multiple participants or were mentioned many times (or both). Data was grouped in three major nodes: barriers, advantages and positive attitudes toward computing, and other background information.

Table 5.1 Summary of nodes in interviews from NVivo

NAME	SOURCES	REFERENCES
BARRIERS	0	0
- BARRIERS TO INTRODUCING TECHNOLOGY	16	66
- THE (PERCEIVED) COST OF TECHNOLOGY	12	26
- TECHNICAL ISSUES	3	5
- RELUCTANCE AND/OR LACK OF COMPETENCE TO USE TECHNOLOGY	3	10
- LACK OF TRAINING IN HOW TO USE TECHNOLOGY	2	3
- GENERAL LACK OF UNDERSTANDING OF THE VALUE OF TECHNOLOGY	9	20
- A SENSE OF HAVING TECHNOLOGY IMPOSED	1	2
- LACK OF SUPPORT FROM THE COMPANY	2	5
- CHALLENGES OF USING TECHNOLOGY	25	143
- TECHNICAL ISSUES (E.G. WHEN TECHNOLOGY BREAKS)	8	18
- RELUCTANCE AND/OR LACK OF COMPETENCE TO USE TECHNOLOGY	11	25
- OVER-RELYING ON TECHNOLOGY	2	6
- NOT PRACTICAL	10	14
- DISTRACTION	4	6
- DEPERSONALISATION AND AFFECTED FACE TO FACE TIME WITH RESIDENTS	10	39
- ADDITIONAL STRESS AND WORKLOAD	15	35
- CHALLENGES OF AGED CARE WORK	2	12
BACKGROUND INFORMATION	0	0
- ROLE AND BACKGROUND	35	37
- DUTY DESCRIPTION	28	39
- CURRENT USE OF TECHNOLOGY IN THE WORKPLACE	32	81
ADVANTAGES AND POSITIVE ATTITUDES TO COMPUTING	0	0
- SUGGESTED TECHNOLOGICAL INNOVATIONS	19	38
- INCREASED RECOGNITION OF THE VALUE OF TECHNOLOGY	21	33
- ADVANTAGES OF POSITIVE COMPUTING AND USING TECHNOLOGY	36	1157
- THE SENSE OF BEING SUPPORTED BY THE COMPANY	17	29
- STRONGER BOND BETWEEN STAFF AND PATIENTS	15	29
- STAFF AND PATIENT SAFETY	12	26
- SAVING TIME, TIME MANAGEMENT	25	76
- SAVING COSTS	1	1
- REDUCING STRESS	27	77
- PROVIDING A SOURCE OF ADDITIONAL KNOWLEDGE	4	8
- POSITIVE IMPACT ON PERSONAL LIFE – MORE TIME, ETC.	13	27
- PHYSICAL ASSISTANCE	13	36
- OVERALL BETTER JOB PERFORMANCE, COMPETENCE AND CONFIDENCE	36	193
- MORE PERSONALISED TREATMENT	26	64
- MORE ATTENTION GIVEN TO THE PATIENTS	21	60
- MORE ACCURATE DOCUMENTATION AND PATIENT DATA	33	127
- INCREASED STAFF ENGAGEMENT	19	35
- INCREASED PATIENT ENGAGEMENT	5	13
- INCREASED COMPASSION	30	53
- INCREASED COMMITMENT	20	30
- INCREASED AUTONOMY	20	30
- IMPROVED COMMUNICATION WITH FAMILIES	6	8
- GENERAL HAPPINESS AND WELLBEING	25	64
- EXTERNAL COMMUNICATION	5	6
- BETTER TRAINING OPPORTUNITIES	23	56
- BETTER CONNECTION WITH THE ORGANISATION	25	42
- BETTER COMMUNICATION WITHIN THE ORGANISATION	26	67

Note: Source refers to the number of interviewees who mentioned a specific issue. Reference refers to the number of instances that issue was mentioned during interviews.

5.4 Exploring findings from the themes in the quantitative analysis

In the following sections the themes arising from the quantitative analysis are explored via excerpts from interviews with 36 care staff at The aged care organisation. All interviewees have been de-identified and a number used to preserve anonymity.

5.4.1 Perceived organisational support -> Positive computing

Perceived organisational support was positively associated with positive computing ($\beta = 0.58$, $p < 0.001$), explaining 35% of the variance of positive computing. This section explores the statistically significant relationship between perceived organisational support and positive computing using data from the interviews. Although some staff had low education levels and did not know theories relating to perceived organisational support and positive computing, they were able to describe how technology supports them and makes them feel more supported and connected to the organisation.

Interviewee 21 described how technology enables them to have an overview of and sight of what is going on in the organisation. This is because the technology enables them to see what is happening and also enables them to engage with other staff, so they feel supported by the organisation and recognise that technology makes them feel part of the team and involved in organisational activities. On this theme interviewee 21 said:

> So we're all interlocked with our technology, which is brilliant, because we can see everything that's happening. From my point of view because it's – we can communicate and engage with everybody, it makes life a whole lot easier, and it's more – it makes you feel more involved, to be honest. It makes you feel part of the team with that technology that's happening.
>
> - *Interviewee 21*

Interviewee 31 used an example of TRACI, which is the aged care organisation's compliance and HR support system used by all staff, including executives. Interviewee 31 talked about how TRACI provided organisation-wide support and promoted teamwork and mutual support between work colleagues. Interviewee 31 felt that the TRACI technology was part of the organisation providing support and being supportive of the employees. Interviewee 31 said:

> TRACI's really good, because it's talking about the whole organisation and how we should treat others as well as ourselves, you know, to look after each other, which is

> really good, you've got communication. It also talks about respect for somebody, and it's not just somebody that you're working for, it's also the resident that you're working with as well.
>
> - *Interviewee 31*

Interviewee 36 also discussed how TRACI promoted cross-organisational engagement, helped to build a community spirit and could help address issues such as bullying. Interviewee 36 revealed how TRACI was the enabler for perceived organisational support through technology and that TRACI had positive effects on staff wellbeing and was viewed positively. Interviewee 36 said:

> They can write to TRACI. They've got activities where, as a team, they get involved on a monthly basis. So I think it's building a community spirit, which the business greatly needs because we do have a lot of older care staff bully younger care staff because they've been here longer.
>
> - *Interviewee 36*

Interviewee 11 discussed how technology kept staff engaged with the organisation's head office. Technology was used by head office to provide support to employees, without which the organisation and staff would struggle. Interviewee 11 said:

> Oh yeah, well I mean [technology] it can have because we need – I mean, as you say we do keep contact with head office for things and they're pretty good at keeping us up to scratch and things, but if we didn't have that support we'd probably would go nowhere because it's their thing. So if we don't have the support of them there's no point even trying to bring it in, unless we do it off our own expense which – that would not happen.
>
> - *Interviewee 11*

Interviewee 10 discussed how the technology can have a positive effect on morale. By providing the staff technologies that supported them in a positive way, staff morale was improved because employees perceived the organisation as listening and responding to the needs of staff. Interviewee 10 said:

> It [technology] does, because if it makes your work easy, then you're going to work more and you want to do more. If it's hard and – you know how people complain if the company don't provide so many things and you just complain and people used to leave. They leave the company. Whereas for me here, everything there is easy and it actually motivates me to stay and do more because they're providing all the things that we needed.
>
> - *Interviewee 10*

Interviewee 12 was very clear on how technology could be used by the organisation to provide them support both now and in the future. Interviewee 12 added:

> Yeah, there is a link, because if [the aged care organisation] provide us with advanced support, it's possible with the technology.
>
> - *Interviewee 12*

Being informed about what was happening in the workplace was a key part of perceived organisational support and decision making for some carers. Interviewee 21 said:

> We have assessments and care plans. The care plan is made up of assessments, so we're able to see what everybody else is doing. So, we get lists of people that need their assessments done and I'm a part of that, but I'm able to see, if you like, different things that nurses have put in there. Like every day we need to look at the handover and see who's vitamised, who's had a fall, because that's part of our job to do physio and if that person's had a fall we can't do physio. So, we're all interlocked with our technology, which is brilliant because we can see everything that's happening.
>
> - *Interviewee 21*

Improvements to internal organisational communication were one of the reasons carers were supportive of positive technologies. Interviewee 15 identified the benefits of technology to communicate with staff rather than just relying on verbal communication:

> If we didn't have those notes, it would be quite hard to keep track of the day-to-day things that's been happening because there's so many residents, there's so many staff. We try and hand it over verbally but sometimes it's missed and sometimes it's a different nurse, so it could get quite stressful without those dated notes.
>
> - *Interviewee 15*

In summary, the data from the interviews provided insight from the carers into how technology, and in particular TRACI and other web-based systems such as training, can support staff, have a positive effect on their morale, and develop the perception that the organisation is supporting them in their work through technology. This supports the theme from the quantitative model that perceived organisational support was positively associated with positive computing.

5.4.2 Positive computing -> Employee wellbeing

The findings from the quantitative study were that positive computing was positively associated with employee wellbeing ($\beta = .25$, $p < .05$) and perceived organisational support and positive computing explained 40% of the variance of employee wellbeing. This supports the hypothesis that positive computing has a small but notable positive impact on employee wellbeing. The interviewees discussed and supported the quantitative finding that technology has a beneficial impact on their wellbeing. The interviewees discussed the ICare system, which

is the patient/resident management system used to store all the residents' data, health and general needs, treatments and reports across the aged care organisation.

The six positive computing determinants of wellbeing (competence, autonomy, relatedness, meaning, engagement and compassion from Calvo and Peters 2015) were seen as an aid in the carers' work, which would enable them to be more aware of and, consequently, more compassionate about the needs of the residents. Being able to use the ICare system to review residents' health and monitor whether or not they were in pain enabled carers to understand or empathise with residents and what they are suffering, and also to plan what treatments the resident required from the carer on the shift. This also benefitted the carers' wellbeing because, by reading residents' notes, they were aware in advance of the residents' needs and could mentally prepare themselves before encountering a resident that might be suffering. Interviewee 17 said that looking at the residents' progress notes at shift changeover helped staff understand whether a resident was suffering and enabled the carer to show more empathy towards the residents:

> Yeah, I suppose it impacts on compassion because especially with progress notes, it'll tell us what's been happening with a particular resident and why it's been happening so we're able to see a picture that we need to provide them and be extra compassionate if, say, someone's struggling and really upset, so that will usually be documented and we'll be able to see that prior to seeing that person and we can understand why they're being like that.
>
> - *Interviewee 17*

Many carers identified how technology impacts how they are connected in the workplace, which demonstrates relatedness, another determinant of wellbeing. The carers felt connected to the company by technology and so felt better supported and less isolated. Interviewee 21 discussed how they would feel less connected to the organisation if technology was not there, and how critical technology was to keeping carers informed of what was happening in the organisation, which therefore improved relatedness both amongst carers but also with the organisation's management. This can be seen in comments from interviewee 21:

> It [technology] can have, because we need – I mean, as you say we do keep contact with head office for things and they're [management] pretty good at keeping us up to scratch and things, but if we didn't have that support we'd probably would go nowhere because it's their thing. So, if we don't have the support of them there's no point even trying to bring it in, unless we do it off our own expense which – that would not happen.
>
> - *Interviewee 21*

Interviewee 18 echoed similar thoughts to interviewee 21, recognising how technology and shift handovers improved communication between carers and reduced the workload and therefore the stress levels of care staff. Using technology such as emails and teams software and residents' ICare records at shift handovers demonstrated how technology is improving relatedness (another determinant of wellbeing) by acting as an enabler for communicating and discussing patients' needs with all the carers. Like interviewee 21, interviewee 18 discussed what the consequences would be if technology were not available to support staff. The tone of interviewee 18's comments suggests the outcome would be higher stress and reduced wellbeing due to a greater workload. This would also lead to less connectivity and cross-team engagement, thus reducing the level of relatedness for care staff:

> If I wasn't getting any emails or handover, then it would definitely affect the way I'm doing my work, because I'd have to spend a lot more time really questioning the residents, and talking with the nurses, and running around to get any sort of information.
>
> - *Interviewee 18*

Interviewee 19 commented on how technology (ICare) helped ensure accountability within the organisation and created clear expectations due to the system being capable of planning workload and work plans for each carer in the organisation. This helped employees to know what was required of them, made them feel more connected to the organisation and feel more supported. ICare could help with organisational justice, which was identified in the literature as having a negative impact on wellbeing, by managing and allocating workloads so that each carer knows what they need to do. Interviewee 19 also brought up how catching up on emails from home could help improve the care levels staff offered to residents by enabling them to spend more time on the floor with residents. This again shows how carers' wellbeing was supported and stress levels were reduced by technologies that enabled them to keep up-to-date with residents' needs and their workloads.

> ICare provides a pretty seamless flow of information from one shift to the next. I've worked in organisations before where it was paper based, and things were always missed. Yeah, I find there's a lot more accountability in terms of having something like ICare, where everything's laid out simply. You can create tasks that then show you when things are overdue. Everyone's on the same page and everyone has access to the same information… So yeah, I really feel like ICare allows us to do a better job… in the old system, once you leave and you go home if you forget something you go home and then you fret about it and you might be stressing about it until the next time that you go to work, because there's no way that you can update anything once you're home. But with this system, we're always connected. Also, because I am only doing two days a week now, I can check my emails from home and stay up to date so I don't have to catch up on 100 or so emails when I get back to work, which takes up time and then

means that I'm not on the floor helping. So, the fact that I can do that from home has a really positive impact as well.

- *Interviewee 19*

The long comment from interviewee 19 is included in full as it demonstrates clearly the impact that ICare has on carer wellbeing in improving their feelings of relatedness. Interviewee 19 provided an example of what happened in the previous system and how they felt disconnected from the workplace.

Carers understood technology (ICare) as supporting another determinant of wellbeing – autonomy in their work. This gave them the independence to work without having a supervisor or manager heavily focused on them. When asked how technology helped them in terms of independent work, respondents said it provided the knowledge they needed to understand the residents and the care they required and so enabled carers to make decisions about what they needed to do for the residents. Interviewee 14 described this as 'self-sufficiency', which they suggested, and also helps working with other team members:

Being self-sufficient, for example. Taking charge sometimes when you have the carer on duty. Yes, autonomy. So, you can work by yourself. You can work in pairs as well.

- *Interviewee 14*

When asked how technology helps them when working alone, interviewee 16 described a situation particularly at night when a resident might need care. ICare allowed carers to assess a situation with a resident and then request help if required. Interviewee 16 discussed how technology supports their confidence and independence when saying that technology at the aged care organisation can help carers think for themselves. Interviewee 16 said:

[Technology] I'd say autonomy because, especially during the night-time, if something alerts you, you can take charge and go assess the situation for yourself and then call for help if needed. It will make [carers] think for themselves I think.

- *Interviewee 16*

Interviewee 8 felt that technology could help carers be more autonomous and that using the data in ICare enabled them to have a better understanding of the residents' needs.

You [by using technology] can be more independent because no-one will tell you what has to be done, because you have to study your resident and you know what you're going to do. You've got to go into ICare to document, to be that independent by yourself.

- *Interviewee 8*

The My Learning system, a training system used at the aged care organisation, also had an effect on the wellbeing of carers and promoted a positive affect toward their workplace, helping carers feel more engaged (another determinant of wellbeing) in their work. Interviewee 11 was focused on how technology supported staff training and they felt more engaged and supported by the organisation:

> The course and everything. So to me, I think that I feel like I've been engaging with [the aged care organisation] through My Learning, because when I go to the website, I know the thing that I'm supposed to do and what I've done. And even they have the [the aged care organisation] website, then use everything that – for me to know about [the aged care organisation] or my work role, if there's anything new, I'm interested in it to level up my work. So that's how I feel like engaging.
>
> - *Interviewee 11*

The interview data showed evidence of the positivity that the carers felt towards technology and how it affects their wellbeing. This is reinforced by the views of interviewee 23, who found that having more technology at the aged care organisation was good compared to other facilities where they had worked. They felt safer with the aged care organisation technology, suggesting that they would not feel safe or feel less safe at the facilities where they had worked previously:

> Yeah, if like – you know, if there's the good technology here, I feel much safer and really engaged to work here. You know, if it's like not a good technology, so be worry for us, you know? It does help, the good and helpful technology here.
>
> - *Interviewee 23*

Technological support helped staff to feel confident and competent in their work in a range of ways, particularly when interacting with doctors. For interviewee 13, competence came with the increase in access to medical information. Being able to use the information provided in ICare and corresponding via email with medical staff allowed them to make decisions on what the resident needed. This improved carers' sense of independence and competence (another determinant of wellbeing), which further improved their confidence and wellbeing. This has important implications for wellbeing because relying on someone for instructions can drain confidence and competence.

> Yeah, even for the residents and even for the staff, so we can communicate with each other through email and you can contact the doctors, we are sending the doctors the information through email. So before it was hard, so we need to call and wait for them, for the reply and stuff.
>
> - *Interviewee 13*

Ease of use of technology was also a factor for improving competence. Interviewee 15 noted that 'at a glance' in looking at technology (ICare) they could see what care was required for the residents, which also promoted a sense of competence and confidence and improved their wellbeing.

> Yeah. That enables us to improve quality of care that we're providing them because we're able to have a look at the care that we're given at a glance. I feel like I'm competent.
>
> - *Interviewee 15*

Technology was also seen as a means of support, which encouraged more confidence in carers and how they performed their role and perceived how they went about their job more positively. Interviewee 16 discussed how the system gave them sufficient confidence in their investigations so that they could discuss and even challenge the registered nurses (RNs), who are the senior medical staff within the care team.

> They might feel confident in what they're doing knowing that there is a system that works for them and then, even when the RN would come and investigate because they'd have to do their assessments and investigation and they'll have an answer to why things happened, so they might have a guide to the event.
>
> - *Interviewee 16*

The six positive computing determinants of wellbeing (competence, autonomy, relatedness, meaning, engagement and compassion from Calvo and Peters 2015) in the context of wellbeing are clearly evidenced in the interview data from the carers.

5.4.3 Other themes related to wellbeing

Various other themes from the interviews aligned with the quantitative data on issues that positively impacted staff wellbeing, including better communication within the organisation, a general sense of happiness and wellbeing, a reduction of stress, improved communication with residents' families, a positive impact on carers' lives, and improvements in productivity and time saving.

A number of interviewees identified stress as a factor in their work and, in particular, identified technologies as a means of reducing their stress at work. Interviewee 16 thought that by having access to the residents' data, treatment plans and work plans for shifts meant that staff did not

have to worry about remembering things or solving problems given that they could access the relevant data as required:

> So, that's where the care of the resident is compromised and the staff are stressed. … I think if your work was made easier through any technology, so if you don't have to physically and mentally stress about what I'm going to do.
>
> - *Interviewee 16*

Interviewee 3 expressed a similar view, discussing how ICare made her happier and made for a better life. It reduced stress because the system stored all the work plans and residents' treatments and data. Interviewee 13 also put the technology of the organisation in perspective given that they worked at other care organisations and that the technology at those other organisations was not as good, and so the aged care organisation was a less stressful place to work and it was easier to do their job. General comments were made expressing the impact technologies had on wellbeing. Interviewee 3 said:

> Personally I prefer the [ICare] system, is making better, my life and residents'… It makes me happier because, you know, everything is systematic, so it's easy to let you do the job better than the previous one.
>
> - *Interviewee 13*

A key part of the roles of carers is interaction with the resident's family. A resident's family is an important part of their care plan and for care staff communicating with the families is essential; these interactions can be positive but also stressful. Families worry about the level of care their relative is receiving and this can be compounded by also feeling guilty about putting their loved one in a home, which can lead to tensions or frustrations when interacting with care staff. A number of carers who were interviewed noted the benefits of technology in improving communication with families. Interviewee 21 identified communication tools like Skype as one benefit in enabling and encouraging contact with the family via iPads because the devices are mobile and could be moved from resident room to resident room so the residents did not need to be moved to a desktop computer if they were immobile.

> The iPads help with contacting family, so we can use it for Skype.
>
> - *Interviewee 21*

Communicating with families could be additionally challenging because of the dispersed location of families, particularly in regional care homes, as distances made face-to-face communication difficult. Interviewee 3 identified how technology, specifically the ICare platform, aided in clear and reliable communication with residents' families:

> It's more easier because of the technology because when – even after one or two months – if any family wants to know about the resident's details, we can look in the note and let them know.
>
> - *Interviewee 3*

These interactions with families can be less stressful when mediated by technology. When families contact the carers they are likely to communicate with different carers rather than engaging with the same individual carer consistently because of the changing shift allocations.

By having up-to-date data in the system, any carer on shift could provide the same information to the family, making communications consistent and timely and putting the families at ease. Interviewee 28 also acknowledged that communication tools help to get information quickly, for example from medical professionals, and share that with families.

> Where we use it often, for example, calling doctors, calling families to keep them updated, so I think in that way technology does help us with connecting to other people, rather than (like in the old days) writing letters to them, it will take them a long time before they find out if anything changes with the residents.
>
> - *Interviewee 28*

However, not all staff had a completely positive view of ICare. Some expressed concerns with ICare in terms of family communication regarding admissions paperwork, which was still significant and which could not be completed by families in ICare. Other possible improvements were identified in terms of how families engage with the aged care organisation staff. Interviewee 19 expressed a view that because phones were not supplied to residents, family members seeking to get in touch with residents often had to rely on staff to forward calls to a resident's room, which can be delayed when no staff are available to forward calls.

> Well, it could be a lot better because at the moment a lot of our paperwork, a lot of our documentation from the family members, is still paper based… We do use ICare… but that's not really something that the families can use.
>
> We don't provide telephones, that's something that the families have to provide. We have our cordless phones which we can transfer through to the house to have someone take it to the resident, but that can also be difficult because if someone's tied up doing a dressing, or in the middle of resident care, they can't always get the phone call through to that person.
>
> - *Interviewee 19*

Some carers thought beyond technologies focused on the workplace and discussed how they felt about technologies that were accessible from home. Interviewee 2 felt that the integration of technologies in their work, and the remote access it allowed, helped improve their work–life balance:

> Now they put it on a computer so anytime in your house you can just go in there and do it on your computer and can do it at any time.
>
> - *Interviewee 2*

This also allowed flexibility, which the organisation encouraged by paying staff to do online training from home. This allowed staff to organise training around family and personal life. Previously, staff were required to manage training in the office outside of their set work hours and shifts, and this could impact family and personal time, especially when also considering travel time. Staff who do not have personal access to computers continue to experience this inconvenience. Interviewee 20 confirmed this when discussing how online access to training had been a benefit to staff, allowing for more convenience.

> We just access it from home, if we want, and it's paid for… It makes life easy because you don't have to come to work on your day off. You can just get on your laptop and do your online training there, and still get paid… I would come, sometimes, at five in the morning, or six, just to do my training, to be up-to-date with them. And, now I don't have to.
>
> - *Interviewee 20*

Interviewee 22 expressed similar ideas on the benefits of doing training at home and even used the word 'relax'. A number of staff had consistent views in how working from home, connecting to the work systems, and being paid brings a better balance to their lives.

> Actually, a lot because I can sit at home and do it on my own computer without having to worry about doing it at work. So, I can sit home and relax. Do it. Tick it off. It comes through saying I have done it at home, and then they pay me for doing it at home. So, there is no pressure to get it done by a certain date. You get a week to do it, and you just relax at home doing it, rather than, "I have got to get this done now."
>
> - *Interviewee 20*

In aged care organisations carers work to a strict work plan and schedule of shifts. Carers are therefore mindful of the time spent on tasks at work, and how to manage that time with competing priorities. Many identified improvements and time-saving elements of technology as a clear benefit of having automated systems that store data rather than having to complete paperwork each shift. Interviewee 1 said:

> It helps us with the time management as well. First of all, we don't spend much [time] doing paperwork. So, it's kind of time management… Less paperwork and so less time to spend on the paperwork.
>
> - *Interviewee 1*

Interviewee 33 suggested that by cutting time consuming work, carers can relieve work pressure and spend more time focused on residents. Interviewee 33 said:

> In terms of wellbeing for carers it cuts time out of their day where they can spend it now with residents. If it cuts that time off documentation, because I know typing sentences and sentences takes time for them… Because it's very time consuming and she – under pressure – a lot of the carers feel under pressure because of the amount of work they are required to do, both documentation on the computers and – versus the time on the floor with residents.
>
> - *Interviewee 33*

Online training courses are also seen as less time consuming, which again reduces pressure on carers. Interviewee 22 said:

> Yes, because before, you had to try and be on the floor, get over and do your course, get back on the floor, and you were leaving someone there on their own on the floor, which was like, "I have got to get this done and get back." Now, you can just sit and relax and do it, so there is no pressure.
>
> - *Interviewee 22*

In their responses, carers spoke of the time-saving benefits of technology in terms of how it frees up time. The tone of these interviews was positive, suggesting that where carers did not need to chase or duplicate paperwork, or where they felt they could rely on consistent information, there would be less stress in the workplace. Technology improved staff wellbeing in a number of ways including better communication within the organisation, a general sense of happiness and wellbeing, a reduction of stress, improved communication with residents' families, a positive impact on carers' lives, and improvements in productivity and saving of time. These themes evidenced from the carer interviews supported the findings from the quantitative data that positive computing has a positive effect on wellbeing.

5.4.4 Positive computing -> Affective commitment

Positive computing had a small, indirect effect on affective commitment ($\beta = 0.12$, $p < 0.05$), with wellbeing mediating the relationship. In essence, this means that positive computing has the potential to boost wellbeing, and this contributes positively to affective commitment. The quantitative findings suggested that technology could improve the affective commitment staff felt toward an organisation, which was explored further during the interviews with staff during the qualitative phase.

Interviewee 16 reflected on a broad range of points relating to the impacts technology had on their work at the aged care organisation, including by promoting engagement, and reducing stress and workload so that carers had more energy to focus on the residents. This compound effect of less stress leading to more time with residents made their job more satisfying, leading

them to think that the healthier work environment made them want to stay longer and increasing affective commitment:

> I think if your work was made easier through any technology, so if you don't have to physically and mentally stress about what I'm going to do or what I'm going to say to someone, you can engage more with the residents and you can relate more to the residents and you will have a meaningful job and you may feel like you've and you feel competent as well. So, all in all, I think people would stay longer. It's all part of – people leaving is all part of stress and not being supported and things like that, so if that were to be addressed, physical stress, mental stress and support, and support can be in any form, by giving them correct or enough help through technology, then so be it. I think the job satisfaction will increase if that was.
>
> - *Interviewee 16*

Interviewee 17 also alluded to the same point interviewee 16 made: if more investment was made in technology, the reasons to stay at the aged care organisation would increase because more technology investment would increase staff motivation. Interviewee 17 commented that technologies support workplace motivations:

> Without them increasing any technology it would sort of inhibit wanting to move forward with the company because you've reached a maximum and you can't really grow any further. But with new technologies comes new challenge and you feel a bit more motivated to continue.
>
> - *Interviewee 17*

Some staff saw investment in technology as a sign that the organisation valued its staff, which created a reciprocal positive effect, therefore increasing affective commitment and perceived organisational support. The staff saw the organisation's investment in technology as an investment in the staff themselves. Interviewee 23 said:

> So the whole – I mean, we are really lucky that – well, I feel I'm privileged to be working at [the aged care organisation], because they are a good company and they do give a damn. They do give a damn about us, you know? They try really hard. They've introduced the TRACI system, which is just wonderful.
>
> - *Interviewee 23*

Interviewee 13 echoed this sentiment, seeing investment in technology as a sign of the employer valuing its staff:

> I think staff will feel more valued as employees and therefore, I think because they feel valued, they'd be more willing to do a better job. I know for me, if I was asking for an iPad to help me do my job and it was given to me to use to do my job, I personally would feel like, "Okay, well they obviously value me as an employee, so therefore, I'm going to put in more work and more effort and do a better job."
>
> - *Interviewee 13*

As mentioned by many other respondents, interviewee 10 reflected on how an investment in technology made their job easier and less stressful, which motivated them to stay at the aged care organisation and work harder. The interviewee noted that if the company did not invest in the technology staff would complain and perhaps leave, impacting affective commitment:

> It [technology] does, because if it makes your work easy, then you're going to work more. And you want to do more. If it's hard and – you know how people complain if the company doesn't provide so many things and you just complain and people used to leave. They'd leave the company. Whereas for me here, everything there is easy and it actually motivates me to stay and do more because they're providing all the things that we needed.
>
> - *Interviewee 10*

Interviewee 23 also commented on how new technologies allow staff to focus on their own wellbeing in the workplace and was a reason for them to stay at the aged care organisation. They also identified how the investment made in new technologies by the new CEO and head office staff made cross organisational support a reason for staff to stay at the aged care organisation.

> So this is what the new CEO and the crew down in Perth have actually introduced and since that has come in, that gives us now a portal. So, we can actually find TRACI on our intranet and if we're having a really crappy day, we can complain to TRACI. Or if we suddenly have an idea that we want to put forward, then we can do that as well. TRACI has a site that we can go onto and we can talk to her. So, that's one of the good things about technology. And connect with each other, because I will quite often say to the girls, "Oh, God, I had to go on TRACI last night because I was feeling like crap".
>
> - *Interviewee 23*

In some cases, technology was viewed as making carers' jobs easier, which leads to further commitment to staying at the organisation. Carers felt more supported and likely to stay longer with their employer, that is, affective commitment, because they were able to maintain a sense of meaning in their work, especially in terms of developing skills and growing in the role. Interviewee 17 said:

> I'm really comfortable with what I'm doing here at the moment, but in terms of growth it would be definitely positive and more beneficial for me to stay to experience new sort of interventions, such as the sensory dementia bed and a couple of other different technologies. It would definitely give me more incentive to hang around for a longer period. Yes. And it would give me probably a bit more meaning to continue here.
>
> - *Interviewee 17*

There are many reasons why employees choose to stay at their place of work. Technology has a role to play and it is clear that it is one of the reasons why some employees stayed at the aged

care organisation. Carers view technology as part of the job mix or a factor in enabling them to stay because it makes their job easier and was seen as an investment in the workforce. This view is reinforced by some carers who had worked for and left other employers that did not invest in new technologies. The views of these carers were valuable in comparing or benchmarking the views across different organisations with different technology capabilities.

5.4.5 Positive computing and proactive care

The quantitative analysis showed that positive computing did not have a significant relationship with proactive care. These results indicate that positive computing can have benefits for the aged care workforce (namely, wellbeing and commitment), however it does not significantly impact the level of proactive care. The interviewees made positive responses on technology and its impact on the care they provide. Most interviewees agreed that technology enabled them to provide better care to residents.

For example, the use of digitised sensor mats on the floor of a resident's room that could be remotely monitored contributed to better care in two ways. First, the sensor could detect a resident's fall in real time and alert the carer. Second, the carer is then free to look after more residents without worrying about checking for a fall or worrying that a resident may have fallen out of bed and was lying unattended for a long time. This gives carers peace of mind and the capability to focus on other tasks. For instance, interviewee 28 said:

> We were having increased rates of falls, and then since they started purchasing those sensor mats – those ones that you put beside the bed – if there's a resident that requires assistance but they still believe that they don't need any assistance, they would always try to get up. But since they put the sensor mats on we will get notified, like our bells or pagers will ring that 'okay, this person is standing up', we have to be there to make sure that we'll be able to assist them before they fell, because they require assistance. So, I think those kinds of innovations and technology really help us in providing care to the residents and making sure that they're safe.
>
> - *Interviewee 28*

Interviewee 5 explored this further, discussing how technology can save time and also give carers more face-to-face time with residents.

> It gives you the opportunity to actually spend enough time with them because with this technology you'll be able to do your work with ease and take you a longer period. It takes you a shorter time and you have leisure time to communicate with your residents.
>
> - *Interviewee 5*

Interviewee 13 discussed how technology improved quality of care due to the residents' behaviour being stored in their personal care records in the ICare system. This was better than a manual process, according to interviewee 13, because digital records cannot get lost and they enable easier follow-up, which supports continuity of care across many shifts from different carers. Interviewee 13 discussed this in terms of how carers can be proactive in caring for the residents, even if they had never met them. The ICare system enabled the carer to develop an understanding of the care required by reading the medical records of the resident.

> I think definitely the quality of care because if I don't know that a particular resident is having a bad day or they've sustained an injury, they've had a fall recently and then I go in to see that resident and provide the care for the day and I don't know those things, you could make a mistake, become frustrated. Especially with dementia, it's important to know, I think at all times, what kind of day that resident is having, I think, because if they're having a particularly frustrated day and you go in to that resident to provide care not knowing that they're not doing so well that day – how cool would it be to have an iPad outside everyone's room with the ICare link on it?
>
> - *Interviewee 13*

Similar thoughts were expressed by a number of carers who reflected on how the recording and storing of the medical history of a resident helps with their care. This is a consistent theme through the interviews. Interviewee 14 said:

> Because, basically, you have the new resident here. As soon as we've put every detail in a computer, it's making it easy for us to make the level of care – how can we approach the resident? What they like and dislike as well.
>
> - *Interviewee 14*

Another aspect of care that was discussed was staff and patient safety. This can be seen with interviewee 1, who discussed how having a medical history stored on a portable device could help carers feel safe with difficult patients who can be aggressive (due to dementia) or upset:

> You feel safe as well, could be as a behaviour or could be because of their medical history, you're safer as well to know what to do with the resident.
>
> - *Interviewee 1*

Some of the themes around improvements to care through technology were seen as indirect. These included improvements to communication technologies to enable residents to engage with family members. Although residents' communication with their family was not considered direct care of the resident, it gave carers confidence and encouraged the perception that residents were being well cared for. Interviewee 3 had views on this theme, mentioning how even historic data could help with communication with residents who had families that did not keep in frequent communication.

> It's easier because of the technology because when – even after one or two months – if any family wants to know about the resident's details, we can look in the note and let them know.
>
> - *Interviewee 3*

Interviewee 28 continued with this theme when discussing how technology has improved the speed of communication, compared to the pre-digital era when it was slower as letters had to be written:

> Where we use it often, for example, calling doctors, calling families to keep them updated, so I think in that way technology does help us with connecting to other people, rather than (like in the old days) writing letters to them, it will take them a long time before they find out if anything changes with the residents.
>
> - *Interviewee 28*

The use of technologies such as Skype or FaceTime to improve family-to-resident communication was discussed by interviewee 25, who was keen on promoting the use of these technologies further.

> As we know, most young people have smart devices, and I think it would be so nice if we could have them be able to FaceTime or call quite regularly. Because there's a big difference between sitting on a phone to be able to see them, as we all know, because we all use Messenger, FaceTime, constantly. So, for them, it would be nice for them to be able to ring up – because we've got residents' families in the UK, America, they come and see them once a year. But wouldn't it be nice to be able to sit down on a Sunday afternoon and see your mum? So I think it would make a big impact on families, strengthening them.
>
> - *Interviewee 25*

Some of the carers recognised how technology could help new residents settle in better when they first arrived at the care home. A review of the literature mentioned "relocation stress syndrome" Brownie at al (2014) where new residents have difficulties adjusting to their new residential home. Carers saw the potential for using technology and ICare as an opportunity for personalised treatment for the new resident right from their arrival, which had the benefit of helping residents settle into their new environment more quickly. Interviewee 14 said:

> Basically, you have the new resident here. As soon as we've put every detail in a computer, it's making it easy for us to make the level of care – how can we approach the resident? What they like and dislike as well.
>
> - *Interviewee 14*

Email was seen as a central tool to effective work as a carer. Interviewee 3 said:

> If there is any information we need to be passed to our staff or the carers, we can email to them. There is, you know, our staff member special email. So, we can communicate

> through emails and all the staff we get the access for the email. So, the information will be up to date… Even for the residents and even for the staff, so we can communicate with each other through email and you can contact the doctors, we are sending the doctors the information through email. Before it was hard, so we need to call and wait for them, for the reply and stuff.
>
> - *Interviewee 3*

The interviews demonstrate that the overall level of care is made up of many factors, and the role technology plays in overall care is varied and can include indirect methods, like keeping families happy and engaged through communication, through to direct administrative benefits like managing medical records. Technologies are seen as enabling the carers to provide better care by having a deeper understanding of residents' needs and being able to respond to those needs quickly and effectively. The qualitative results varied from the quantitative results in that the qualitative data provided more evidence and insight from the carers on how technology enables them to provide better care. It is likely that answering specific questions on the Likert scale in the quantitative phase required a more specific answer whereas the semi-structured interviews in the qualitative phase enabled the carers to expand and reflect in more detail on how they provide care and the impact technology has on the level of care provided.

5.4.6 Tensions in themes: Carers expressed negative views

Carers discussed the benefits and the positive side of technology but, as the quantitative findings showed, explanation was needed on why the correlation was not higher between certain factors. Although most of the carers' comments on the impact of technology on their wellbeing were positive, carers did identify some negative impacts, including the negative impacts of technology related to the medication system, the perceived cost of technology and its impact on budgets, and concerns about technical issues.

One area where care staff identified a lack of technology caused problems and concerns was the manual medication system. Because this was a manual system, it was seen as prone to human error. This caused the carers great stress as they were afraid of providing the wrong medication to residents, which could have serious consequences on the health of the resident. Interviewee 21 felt a computerised system would help:

> I think it would be good to have a computerised medication system because, at the moment, we have it on paper-based. I was a carer from another facility that's got a computerised medication system, and it's quicker and it's clearer, having it on the screen, and there's less mistakes, less errors, having it on the screen than on the paper that you have to flick through the pages.

- *Interviewee 21*

Interviewee 35 had similar views on having to use a manual medication system:

> Systems-wise, with medication, because we're still on paper. The other facility I've worked at previously, we had ICare for medications as well, and I just found that that was a lot more effective. With medication rounds, I think signatures on things are always missed, whereas the system I was using before, it alerts you if you haven't administered a particular medication. So, it just alerted you to that, and then you'd put a reason in, or you'd go, "Oh, actually, I did give that," and you'd sign that off. Whereas on the paper, it's easy to miss when you're signing.
>
> - *Interviewee 35*

When reflecting on the potential negative impacts of technology, carers' experiences with this system informed some of their thinking, although this did not necessarily lead to a negative view of technology. They felt technology could improve the handling of medication and reduce errors, bringing a higher level of care to the resident and also bringing more confidence to carers and reducing their stress. If a computerised medication system was implemented, there would a significant increase in the wellbeing determinants of positive computing and improved perceived organisational support.

Although carers could see the benefits of investment in technology, some staff mentioned that one of the biggest difficulties of investment in technology was limited funds. This was a significant theme that emerged in the qualitative findings. Interviewee 36 expanded on why the organisation might have limited access to resources:

> I think, for me, one of the biggest challenges that we face is how we're funded. You know, if we were industry and we had penalties from clients and what-not for not hitting our KPIs, the business would invest and invest and invest to mitigate those risks. But because we don't have that and we're not-for-profit and we're only funded by the government, there isn't that flexibility in resources and investment to be able to be the best that we can be.
>
> - *Interviewee 36*

Other carers also expressed doubts about access to resources. Interviewee 13 said:

> Staff have asked for things before in terms of technology and told it'll cost too much money. They're not having it… They see the upfront cost rather than the long-term benefit and not just a money benefit but allowing people to do their jobs better, making people want to work for [the aged care organisation] because, "Hey, [aged care organisation], care about us".
>
> - *Interviewee 13*

For interviewee 36, it was not necessarily the case that the organisation could not afford new technologies, but that it spent its money on other priorities:

> I think they use the excuse… But that's the biggest excuse. You know, we waste millions and millions of dollars because we'll employ a consultant to come and say something. We don't verify whether it's accurate or not, we just take it as random. We spend millions and then 12, 18 months down the line, we go "Maybe that wasn't right." If we took that money and invested it wisely or employed the right people who could make those decisions internally, we probably could have all the things we needed but it comes down to the right recruitment of staff, right recruitment of senior managers. And while you're going to replace like for like, you're never, ever going to get that.
>
> - *Interviewee 36*

The interviewees framed these issues as negative because they limited the benefits that technology could bring to their roles. However, the carers were keen to see more technology and could see the potential of technology to improve their performance at work and also the quality of care.

Interviewee 24, in response to questions about the organisation's investment in technologies, had a negative view and was critical of the management and perceived organisational support:

> I don't think it has done a huge amount. Yes, they have implemented this great TRACI program, what have you. But unless they are really putting their money behind their mouth with what they are saying they are doing, togetherness, respect, accountability, caring and integrity, unless they are really putting all those things in practice into our wellbeing as staff, which I don't feel that they are at the moment in many ways, and I am probably not on my own, I don't feel that they have succeeded very well. Not at the moment anyway.
>
> - *Interviewee 24*

A number of other concerns were raised about technology, included a reluctance or a lack of competence to use technology, a concern about over-relying on technology, feelings that it was not practical or a distraction from their work, and that technology might lead to a distancing between carers and residents. In some cases, technology was seen to be getting in the way of care provided to the residents and making care too impersonal.

The theme of a lack of competence to use technology was also reflected in the literature (Numez 2015; Productivity Commission 2015), where it is recognised that there is a lack of innovation in sections of the aged care industry and also that staff needed to be trained to be a digitally literate workforce. Some interviewees expressed concern that not all staff members would be equally capable of using technology. For example, interviewee 16 indicated that new technologies are not always easy for older employees to use and benefit from:

> I think it'd be a positive impact but then there's also – not trying to be ageist – but there's also your employees who are of old age and don't like learning new things and might feel like they're out of depth when new things are introduced and they might take some time to learn or just get frustrated as they go. So, I think for that generation, it'd be a little bit of a con but more so, I think we will benefit from having more than not having more technologies or innovation.
>
> - *Interviewee 16*

Some carers identified that, when using new technologies, a lack of training in how to use the new technology may lead to stress and additional work as it was adopted, leading to a reduced level of innovation diffusion. Interviewee 17 an occupational therapist made this point about assessments that were relegated from allied health staff to nursing staff:

> I think they've tried to take certain pressures off certain staff and give them to other people. So, for example, like a couple of assessments that I was doing when I first started here had a couple of extra parts to them, but they've now removed them from my assessments and added them to registered nursing to cut back on the hours that they had to fund for occupational therapy staff. Which I know from talking to a couple of nurses that they have found that there's been minimal training for them in that area, so why has it been added to their assessment? So, they're asking me to put a toolbox in place to teach them how to do that because I was doing it beforehand. So that's added pressure for them, and maybe a little bit of stress sometimes.
>
> - *Interviewee 17*

For some care staff, the lack of training also detracted from the benefits of technology in supporting them and so they did not see technology as a positive influence in the workplace. Carers were frustrated, particularly when there was also a lack of training. Interviewee 23 said:

> I get really frustrated with technology and I hate the fact that everybody walks around with a phone in their hand. I hate it. We're not allowed to do it here, but we sneak in sometimes… I think that it could be done better, you know, I think there could be education about the systems that are in place and what we can use them for, because you're sort of, you're left to find your own way around the systems to a degree, so you're not – I mean, you're given a glossary of, oh, this is our site and this is where things are, basic, but you virtually have got to find your own way through the maze of technology that they have. So that can be a bit frustrating, when you don't know where to look for information.
>
> - *Interviewee 23*

Some interviewees discussed how technology might increase the distance between carers and residents, rather than decreasing it. Interviewee 23 said:

> I find that it's an inanimate object and it's – I understand why we need computers, because we have to record everything that happens with our residents and learning systems and stuff like that – but it lacks the emotion, I think.
>
> - *Interviewee 23*

This theme of technology diluting or depersonalising the care provided created a conflict for interviewee 23, who also identified emotional connection and familiarity with the residents' needs as a key element of their role.

> Because I'm a carer, I don't have the clinical knowledge that comes from the RNs and the doctors and that sort of thing, but for me it's more than that. It's an emotional thing that you can – you know, sometimes you just know. You walk into a room, you know your resident because you've been working with them for a while, and you just think there's just something not right here, something that I need to find out what's wrong, and because of – if they have a diagnosis of dementia or some sort of diagnosis like that, then we need to be able to express – you can't just put into a computer "they didn't look right".
>
> - *Interviewee 23*

The depersonalisation of care brought about by technology was also discussed by interviewee 27, who expressed concern that pre-set systems did not allow for the personal nuance that carers see in their roles.

> Sometimes in the computing program that we use, they have drop-down boxes, but the drop-down boxes do not give us – in some instances – do not give us a space where we can write other things. Like, they're very just set.
>
> - *Interviewee 27*

The availability of information about residents was generally perceived as beneficial, but not all carers agreed that technology always aided connection. Interviewee 7 expressed concern that online communications could lead to a lack of connection between carers and managers.

> I feel when all the emails are shared online, we don't meet the person like physically, and it makes it a little bit disconnected. Like, we really don't get to know that person. Like, when our managers send us email without firstly meeting us, we get the message, but we don't really meet the person. So, we're left a little bit distant.
>
> - *Interviewee 7*

Similarly, interviewee 29 expressed a preference for face-to-face interaction with patients rather than an over-reliance on technology. However, when used correctly, technology would allow the carer to spend more time with the residents, which was a point that conflicted with what other carers said.

> There is a certain amount of time I absolutely have to spend on the computer and I wish that wasn't so because I would prefer it for all of our patient interventions to be face to face.
>
> - *Interviewee 29*

One theme that arose on the limits of technology-aided care was the limits of technology in helping carer wellbeing and improving the quality of the care they could provide. Interviewee 23 expressed doubts that technology would be able to provide the emotional connection required to understand patients' needs. Referring to robot technologies, interviewee 23 also spoke of the importance of having people in the care role:

> It's the same with that robot person that they've got that goes in and dances and talks to them and says, "Good morning," and you know – "And it smiled at me?" Well, yeah, carers smile at you every morning and you know, I don't know of a carer that ever walks into a room and doesn't say, "How are you today?" You know, "Are you having a good day?" Or ask you what sort of a day you've had. So, you know, these adverts and stuff that I've seen that they've done with these robots, it's all about, "And it knows my name and it smiles at me," and I'm thinking, "Yes, but so do we, and we've been here for years."
>
> - *Interviewee 23*

5.4.7 Other themes on technology

A number of interviewees brought up broader themes on how technology is used in the aged care context. Carers expressed that, although technology brings benefits, there are some limitations to care that electronic and digital technologies can provide. For this reason, the introduction of new technologies into the aged care sector must always retain a place for human carers.

A number of other themes arose infrequently that are not explored in depth: external communication, better training opportunities, better connection with the organisation, better communication within the organisation, a stronger bond between staff and patients, staff and patient safety, saving time and time management, and saving costs.

5.4.8 Promotion of technology to take up innovation

Interviewees expressed a positive view toward technological innovation and its impact on their work and wellbeing. Interviewee 16 agreed that there was a positive impact from innovative technologies but expressed concern that new technologies might be a source of frustration for those less familiar with computers. Interviewee 23 was grateful for the introduction of the TRACI tool. Interviewee 14 also felt innovation was a positive element to their work:

> When we give feedback on the improvement of the technology that we use it to why it's making our lives better. And when you see it happening, I think that's quite good

> and when you observe that this can be impactful on the level of care that we provide this feedback, then I think it's quite positive. I think there's a link between innovation.
>
> - *Interviewee 14*

Interviewee 5 noted that innovation generally led to an increase in and improvement of resources, which made the carer's role easier:

> When you're talking about innovation it means that you're trying to improve what you have or what is happening to you. And also, to bring in more resources, so more equipment to make the carer's job more easy and easier to do. So it's been – including bringing in technology – I've been bringing in new technologies and adding improvement of already existing technologies has been quite helpful because there are health issues we've considered, which is the main thing. And also, the condition of the residents is also being considered before the technology or the improvement of this technology, the innovations. Before these innovations actually have been brought about, so there's a connection between them and it's quite useful.
>
> - *Interviewee 5*

Some carers saw the industry as stymied in terms of innovation because of the limited pool of human resources and experience in the sector. Related to the restricted investment in technology, the lack of innovation and investment in IT in the aged care sector is well-recognised (ACIITC 2014). Interviewee 36 made a very relevant point that the inward looking nature of aged care recruitment processes, which is partly due to the vocational and religious nature of parts of the industry and also the difficulty of attracting new people to an industry that outsiders have a negative view of, has a clear impact on innovation and technology investment:

> No, no, it's not an excuse but when you've got a limited resource, it then becomes, where do you put it? And the difference – I think the one thing that I think holds our industry back, and even holds it back from a technology perspective, is when you look at private industry, you know, whatever industry it is, the turnover and the change of management is because they are exposed to different things, they want new opportunities, but then who you replace those people with usually have a wealth of different experience and so you've been exposed to so many different things and you can always bring something new to the table. Whereas the aged care industry – and you look at any advert from any company that's advertising – all want aged care experience. So, it becomes very incestuous and actually you're not inviting innovation and technology and improvement into the industry because you're replacing like for like and if you're never exposed to anything externally, you can't then regenerate new ideas, necessarily. …So, you're not encouraging innovation unless you came from somewhere that was quite progressive and was doing things differently.
>
> - *Interviewee 36*

Netflix is a form of technology that has helped the residents and the carers to have a better relationship. Interviewee 19 said:

> We have – I'm trying to think of other forms of technology we have here, I mean apart from – we don't have smart TVs or anything like that. I do believe we've just had Netflix installed though, which has been quite successful with the residents and watching marathon movies on the weekends when there's not much else to do.
>
> - *Interviewee 19*

5.5 Conclusion

The thematic findings in the qualitative data add to and support the findings from the quantitative data that technology has a positive effect on the wellbeing of carers and can also help improve the quality of care provided to residents. Most interviewees frequently discussed how technology might improve the quality of care they provide to residents. They could also see how these technologies might improve their accuracy and ability to use patient data. Other notable benefits that were identified included saving time, reducing work stress, and improving communication overall within the organisation. Overall, the data reflects that most staff were supportive of technology and could see that technology can help their own wellbeing. They could see that technology could have a beneficial impact on their family and work–life balance. Positive responses about technology outnumbered negative responses quite considerably.

However, there were tensions evident in the views of the carers on technology including concerns about depersonalising care and technology increasing the workload rather than decreasing it. Nevertheless, the negative responses provide insight into the areas that need attention to improve how technology is perceived in the workplace and what issues might need to be addressed.

As discussed in the literature review, there is a little research and body of literature in relation to positive computing, as discussed by (Calvo & Peters 2014) and Pawloski (2015). The literature highlights the need for further understanding of how technology-induced changes might create positive change, particularly in a workplace context, remains a core research question in positive computing (Calvo & Peters 2014). This leads to a core research question that must be addressed: "How is it possible to create technology-induced changes which improve the employees' situation and are perceived as positive?" (Pawlowski et al. 2015, p. 407). The findings from the interviews in this chapter indicate that aged care staff have provided some insight into answering Pawlowski questions altought more detailed research is required.

Australia's National Digital Health Strategy (2018), developed by the Australian Digital Health Agency, recognises the aged care workforce as essential in the diffusion of innovation and suggests strategies to improve access to digital technologies for both informal and professional carers (ACIITC 2019). Aged care workers are key "to the successful use or adoption of technology in aged care facilities – not only as users but as influencers for the elderly" (Robben et al. 2012). This was explored in the interviews and supports the views of the the National Digital Health Strategy (2018), which recognises the aged care workforce as "critical to the diffusion of innovation in the industry".

Calvo and Peters (2014, 2015) have also noted that the productivity mentality is another factor that should be considered in the design of positive technologies. While measuring performance can be useful as a tool for personal reflection and improvement (Rivera-Pelayo et al. 2012), there are other risks associated with this mentality. Participants in this research, for example, expressed that being able to work and study at remotely between shifts was a positive convenience. Yet expectations of working from home out of hours could lead to the "tyranny of productivity" (Gaggioli et al. 2017, p. 493), which can have negative impacts on the wellbeing of those seeking positive change. The interviews supported the view of Calvo and Peters and provided further insight as to how productivity can be improved from an aged care staff view.

It has been noted that technology presents an opportunity to implement positive changes, but the challenge remains in determining how to achieve them (Diefenbach 2018; Kanis & Brinkman 2009, p. 127). In order to expand research in positive computing, "interdisciplinary research that draws together positive psychology and information systems is needed" (Pawlowski, Jansen & Koch 2015). This research needs to "reconsider current information systems models, and could be broadened to include metrics that extend beyond ease of use and instead include both organisational performance and individual wellbeing" (Pawlowski, Jansen & Koch 2015). The data and insights from these interviews also provided evidence on the role of carers in the diffusion of innovations or as agents of diffusion as their views, whether positive or negative, can have an impact on the rollout of technology given the frontline nature of their work. In summary helping to contribute to the research questions asked by (Pawlowski, Jansen & Koch 2015) and (Calvo & Peters 2014). This thesis also is the first to develop an instrument to measure the impact of positive computing albeit in an aged care context but

nevertheless provides insight into the questions asked by various researchers into Postive computing.

Chapter 6 answers the research questions by discussing and integrating the results from the quantitative and qualitative phases to answer the research questions.

Chapter 6: Discussion

6.1 Overview

The purpose of this research has been to conduct an explanatory study on the manifestation of positive computing in the aged care workforce and its effect on care outcomes. It sought to study the role positive computing plays in the wellbeing of aged carers and to assess if positive computing has an effect on the diffusion of innovation in aged care organisations. This research is relevant and timely given the current challenges the aged care industry faces and the recommendations of the Royal Commission into Aged Care Quality and Safety (2021), which identifies the need to develop a highly and digitally trained aged care workforce to meet the current challenges and future needs of an ageing Australian population.

Innovation and technology research in an aged care context is a growing research area. However, there are still major gaps in the literature on approaches to drive innovation in aged care (Numez 2019). Positive computing research is also in its infancy and non-existent in the aged care context. In particular, there are gaps in the literature on the effect of technology on the wellbeing of aged care staff. Given the sparsity of research, an explanatory pragmatic multi mixed methods approach was chosen as the most suitable research design. The research was carried out at one aged care organisation in Western Australia, which provided full access to their staff and facilities. The previous two chapters presented the results from the quantitative study and the qualitative studies. Together, as part of a sequential explanatory research design, the results from the studies evidenced the manifestation of positive computing on aged care organisations, care outcomes, and the effect on the wellbeing of carers in a residential aged care organisation as well as carers as a source of diffusion of innovation.

This chapter outlines the implications of this research and its findings for future research, theory, policy and practice. First, this chapter summarises the findings from both the quantitative and qualitative phases. With reference to the research hypotheses, the chapter summarises the findings and proposes considerations to guide future research, practice and policy.

A literature review was conducted to identify barriers within the aged care sector, including the pressure on sustaining the aged care workforce and their importance to the sustainability of the industry; the challenges of technology innovation; the importance of technology to the

sustainability of the industry; and how aged care staff are critical to the diffusion of innovation and technology in the sector. The literature also included possible technology theories or lenses that can help diffuse technology and also support the retention and growth of the aged care workforce. The wellbeing of the aged care workforce and the difficulties of the jobs and job demands were also identified as challenges. The literature was also reviewed to identify manifestations of positive computing in aged care and other sectors but, as identified above, there has been little research in this area.

The literature also identified tensions that emerged from the reluctance to innovate, the under investment in technology in the aged care sector, the very limited research on the manifestation of positive computing, and the need to develop a digitally trained aged care workforce to meet future demands. This research took the approach of applying a new lens, positive computing, to these ongoing challenges rather than applying traditional theories in information technology. By applying a new lens, this research seeks to identify ways to expedite innovation and technology investment in the aged care sector.

Innovation was identified in the literature as necessary to overcome the barriers in the aged care industry (ACIITC 2017; Nunez 2019; Nusem 2016). According to the ACIITC (2017), the aged care workforce is key to the diffusion of innovation and technology across the industry. For this reason, although a number of innovation frameworks were investigated, the diffusion of innovation theory was selected as central to this research because it was in keeping with the acknowledgement in the literature that aged care staff are key to the future of the industry (ACIITC 2017; Productivity Commission 2011).

The literature review also identified the importance of attracting new people into the aged care workforce to meet the future demands of the industry. Research is needed to better understand ways of retaining and growing the workforce. Improving the wellbeing of the workforce may be a valid approach to attracting and retaining care workers to the industry, and positive computing offers a lens through which to better understand the relationship between innovation, technology and wellbeing.

The gaps and considerations identified in the literature enabled the development of five research questions addressed by this thesis. The research questions are:

1. How does positive computing manifest in the context of aged care work?
2. To what extent does positive computing affect the work outcomes of aged carers?
3. To what extent does positive computing affect carer wellbeing?

4. To what extent does positive computing affect the provision of care?
5. How can positive computing promote diffusion of innovation in aged care organisations?

In seeking to provide an explanatory study on the manifestation of positive computing in aged care organisations and its effect on care outcomes, this thesis reviewed the relevant literature and identified key areas requiring further study. The findings from both the quantitative and qualitative phases of research are now reviewed to provide insight on the research questions and offer suggestions for future research.

6.2 Summary of findings

In the quantitative study, structural equation modelling analysis was used to answer the research questions and produced a number of findings. The majority of findings from the quantitative study were supported by the qualitative studies. The qualitative studies also produced key additional findings highlighting how positive computing manifests within an aged care context. The first finding relates to the benefits technology has on the work–life balance of carers. The second finding identifies the impact of the lack of funding in technology in the sector on carer wellbeing and confidence. The third finding indicates how technology can improve the relationship between carers and residents' families, giving families confidence that their loved one is being well cared for. By using a positive computing lens in designing and executing the research, rather than traditional paradigms used to understand the impacts of information technology, this research demonstrates the role played by aged carers in the diffusion of innovation. The following sections explore each of the hypotheses framed in the research design and the degree to which these were supported in the data analysis.

6.2.1 The manifestation of positive computing in aged care

The first research question sought to explore the manifestation of positive computing in an aged care organisation. The first hypothesis tested in this research was positive computing is positively associated with perceived organisational support. Table 6.1 shows that the quantitative and qualitative studies supported the hypothesis that perceived organisational support was positively associated with positive computing. In particular, the qualitative

analysis confirmed a strong link between perceived organisational support and positive computing.

Table 6.1 Summary of research findings for H1: Perceived Organisational support is positively associated with Positive computing

Hypothesis Number	Evident in the Quantitative findings	Evident in the Qualitative findings	Conclusion
H1	Yes	Yes	Supported

6.2.2 Positive computing and work outcomes

The second research question sought to explore the effect of positive computing on the work outcomes of care staff. In answering this research question, three hypotheses were posed: positive computing has an effect on carer wellbeing (H2); positive computing is positively associated with carers' proactive care (H3); and positive computing is positively associated with carers' affective commitment (H4). Table 6.2 summarises the degree to which the findings support these hypotheses.

Table 6.2 Summary of research findings for H2, H3 and H4

Hypothesis Number	Evident in the Quantitative findings	Evident in the Qualitative findings	Conclusion
H2	Yes	Yes	Supported
H3	No	Yes	Somewhat Supported
H4	Yes	Yes	Supported

The findings supported the hypothesis that positive computing has a small, but notable positive impact on employee wellbeing (H2). This hypothesis was also framed as one of the research questions. Although the relationship was weak in the quantitative study, it was strongly supported by the qualitative data.

The hypothesised relationship that positive computing was positively associated with proactive care (H3) was not supported by the analysis of data in the quantitative study. However, in the qualitative study carers in the interviews discussed how technology can improve the care they provide. A likely explanation is that the questions used in the quantitative survey did not give carers the opportunity to think and reflect in detail on the relationship between technology and

the provision of care. However, when prompted by the semi-structured questions in the qualitative phase of research and when given an opportunity to reflect and provide more detail, carers were able to provide broader responses. It was very evident in the qualitative study that hypothesis 3 was strongly supported. This hypothesis was also framed as a research question.

The hypothesised relationship that positive computing is positively associated with carers' affective commitment (H4) was supported in both phases of research. Positive computing had a small, indirect effect on affective commitment, with wellbeing mediating the relationship. In essence, this means that positive computing has the potential to boost wellbeing, and this contributes positively to affective commitment. This was supported in both the quantitative data and the qualitative data.

These results answer the second research question, which asks to what extent positive computing affects the work outcomes of aged carers. Positive computing can have positive outcomes and benefits for the aged care workforce and these outcomes manifest as improved employee wellbeing, higher levels of affective commitment and improved levels of proactive care.

Research questions 3 and 4 explore the relationship between positive computing and the provision of care and were both addressed above. Research question 4 explored the relationship between positive computing and its effect on wellbeing. The quantitative data showed positive computing was positively associated with employee wellbeing and that perceived organisational support and positive computing explained 40% of the variance of employee wellbeing. This supports the hypothesis that positive computing has a small, but notable positive impact on employee wellbeing. Research questions 4 ask the extent to which positive computing affects the provision of care. It is clear that there is no direct effect as positive computing did not have a significant relationship on proactive care in terms of quantitative data. However, the carer interviews made clear that carers felt they provided better care with the use of technology because it improved the quality of care. In combination with other factors as part of an overall mix, carers suggested that positive computing could positively affect the provision of care.

6.2.3 Other findings and themes

Perceived organisational support was also positively associated with employee wellbeing and affective commitment, however it was not directly associated with proactive care. There was

evidence of full mediation (indirect effect) between perceived organisational support and proactive care, with this occurring through affective commitment which was the only construct with a direct, significant effect on proactive care. The qualitative analysis also confirmed a strong relationship with these findings from the quantitative analysis. It is worth noting from the strong relationship that the influence of perceived organisational support and its links to technology can have an influence on these factors.

6.2.4 The influence of positive computing on promoting innovation

The fifth research question of this study sought to explore the effect of positive computing on innovation in aged care work organisations. A fifth hypothesis which evolved in responding to this research question suggested that positive computing supports aged care staff positively in the diffusion of innovation in aged care organisations.

Although this hypothesis was not tested during the quantitative study, it evolved and was explored with carers during the qualitative phase. When carers were invited to discuss innovation during the interviews, they tended to respond by talking about the benefits of perceived organisational support. This may reflect a misunderstanding of innovation or may have been a proxy carers used for innovation. For example, some carers discussed the challenges presented in the rollout of new technologies in terms of a lack of funds or a lack of training rather than discussing the technologies themselves.

Yet despite this possible misunderstanding or proxy for the concept of innovation and the role carers play in its diffusion, the analysis from both phases of the research suggests that carers play a critical role in the diffusion of innovation even if that role is not consciously identified. This occurs because carers have a positive view of innovation in the form of new technology, which is identified by carers as a source of support from the organisation, and as improving their wellbeing and their effectiveness. To answer the fifth research question, a positive computing lens used in analysing carers' responses makes clear that the diffusion of innovation manifests as an outcome of carers' work, even where carers are unaware that this is the case.

6.2.5 Conclusion

The findings indicate that the manifestation of positive computing can have benefits for aged care organisations and their workforce. Taken together, these results suggest that aged care organisations that put in place a supportive, social exchange culture (i.e. those that have high

perceived organisational support) are more likely to put in place technological practices that are commensurate with positive computing. In such settings, positive computing has the ability to improve employee wellbeing and affective commitment and, to a lesser extent, a higher quality of proactive care.

The qualitative studies also provided more insight into the difficulties and slow uptake of innovation in the aged care industry. When using a positive computing lens, the positive outcomes associated with the use of technology are clear in the benefits to families of residents and in improving the work–life balance of the organisation's care staff. The qualitative data supports the overall quantitative themes and also produced further insights into the role of technology and the critical role it has in job satisfaction for care staff. Positive computing can be part of the overall mix that can help to improve carer wellbeing and effectiveness. Positive computing is also a way to consider innovation at the frontline in aged care. The qualitative evidence, when evaluated using a positive computing paradigm, suggests that the positive views of carers toward technology make carers critical in the diffusion of innovation. This is the case even where carers are not conscious of their role in the diffusion of innovation.

6.2.6 Theoritical Contribution

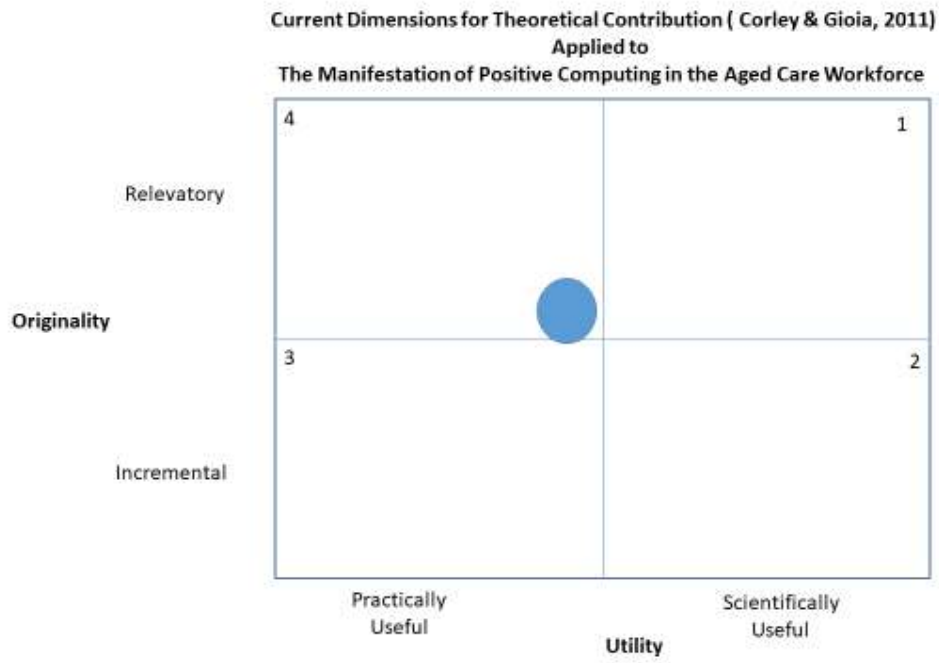
This thesis seeks to make an original theoretical contribution through the findings of the research. Contributions to "theory are successful where they contribte useful and original ideas to the pre-existing discourse" (Kilduff 2006, p. 252). The research provided in this thesis contributes to theory in its originality, its contribution of new insights, and in its utlity given the little research to date into positive computing and also that, for the first time, positive computing has been researched in an aged care context.

The purpose of "original research is not only to produce novel findings, but to ensure such findings progress or extend the knowledge or discourse that already exists on a given topic" (Kaplan 1964; Whetten 1989, p. 491). The research in this thesis achieves both outcomes by developing a new survey instrument for assessing the impact of positive computing in the aged care workforce by adapting pre-existing instruments used in previous research. The research also contributes significant findings regarding the perceptions of positive computing in the aged care sector, a field of study that is still developing.

Another marker of the contribution of this research is its potential utility. As argued by Van de Ven, "good theory is practical precisely because it advances knowledge in a scientific

discipline, guides research toward crucial questions, and enlightens the profession of management" (Van d Ven 1989, p. 486). Useful research "should create the potential to change perceptions about a given issue" (Mintzberg 2005, p. 361). Broadly speaking, "utility can be described as whether research improves the understanding of a specific idea or increases researchers' capacity to further test and analyse the issue; it increases structure and cohesion of research questions and design" (Van de Ven 1989; Kerlinger 1973). In short, theoretical contributions help increase understanding of issues that should be studied and how they interrelate. In providing new insights into an under-studied research area, this thesis contributes to a broader discourse of positive computing and innovation in aged care, and proposes areas for further anaylsis and research. The new survey instrument may be developed further, used and tested in future research to ensure further studies may build on this knowledge base.

Figure 6.1 Current dimensions for theoretical contribution



According to Corley and Gioia (2011), their 2X2 matrix can be used to assess the contribution of research based on originality and Utility.

6.3 Contribution to knowledge

While the literature on aged care continues to evolve, the role of innovation in the industry to meet the current and future challenges of an ageing population is clearly identified in the literature. This research has contributed to the literature in two areas: positive computing and the diffusion of innovation within the aged care industry.

6.3.1 Positive computing

The literature on positive computing remains in its infancy and is not yet widely embedded in research on information systems. Consequently, there are calls to contribute more to this field of study (Pawlowski et al. 2015). This is, in part, because it diverges from traditional approaches to information technology research that primarily consider factors like workplace efficiency (Calvo & Peters 2014). A lack of evidence-based research presents a challenge to understanding the potential of positive computing in achieving positive wellbeing (Pawlowski et al. 2015).

This thesis is the first this researcher is aware of that explores and measures positive computing in a not-for-profit aged care context and, more specifically, the ways positive computing manifests in that setting. To our knowledge, this research is also the first to develop a scale specifically for measuring the impacts of positive computing. This thesis therefore answers the call of Pawlowski et al. (2015) for further research into positive computing, as well as providing guidance on the objective stated by Calvo and Peters (2014) to develop processes that have a positive effect on the organisation and individual workers.

Given the field of research into positive computing is relatively new, there is little critique of the paradigm in the literature to draw on. This can be viewed as an opportunity to do further research into the role of technology in supporting carer wellbeing and designing processes for wellbeing in technology design, rather than only as a means of improving organisational productivity or efficiency.

6.3.2 Diffusion of innovation

As discussed in findings a potential fifth hypothesis evolved during the qualitative phase interviews with the care staff. Thus it is hypothesised that positive computing can support aged care staff in the diffusion of innovation in aged care organisations.

The aged care sector needs to innovate to meet its current and future challenges (Nusem 2016). The aged care industry has struggled to innovate (Productivity Commission 2011) so examining innovation theories that can improve the rate of innovation in aged care is important. A critical factor for the success of innovation is the adoption of an innovative product or service. Everett Rogers studied adoption behaviours in innovation and developed the concept of the diffusion of innovation (Rogers 1962, 2003). Aged care workers are key if new

technologies are to be successfully adopted in aged care facilities – not only as users but as influencers for the elderly (Robben et al. 2012) and this has been reinforced by the National Digital Health Strategy by the Australian Digital Health Agency (2018) which recognises the aged care workforce as critical to the diffusion of innovation in the industry.

According to the ACIITC (2019), it is clear aged care staff will be essential in the diffusion of innovation in the aged care industry. In examining the question of innovation through the lens of positive computing, this research found that aged carers are already a central element in the diffusion of innovation in the aged care sector, and yet many may not be conscious of their role. Care workers spoke of the rollout and implementation of new technologies in terms of organisational support, as well as improvement to wellbeing and effectiveness. This positive perception of new technologies helped ensure technologies were embedded in the workplace. Seen in this way, carers do not identify themselves as agents of innovation, yet innovation manifests in indirect ways through their daily practices. This may suggest that where organisations invest time in carers and their wellbeing, carers can also support the diffusion of innovation. Further research is required.

6.4 Implications for further research

Positive computing is a new paradigm and integrating it into an aged care organisation's strategy and IT design is not easy. The outcomes of this thesis suggest that positive computing can be part of the overall mix in a workplace that contributes to employee wellbeing. However, this study and its findings were based on one not-for-profit aged care organisation in one state of Australia. Further research across more aged care organisations and different industries should address these gaps and develop more evidence to justify the role of positive computing as part of an organisation's strategy and job design. This study should act as a base for future research into positive computing in other industries or organisations. Further research can also be conducted making use of other theories where positive computing has potential.

One such theory worth further consideration is the "job demands–resources (JD-R) design model" (Bakker & Demerouti 2007; Demerouti et al. 2001), which can be used to "predict employee engagement, burnout and performance". The JD-R model classifies causes of occupational wellbeing, regardless of the specifics of a given role, into two broad categories: job demands and job resources. When job demands are high, employees rely on mental and physical resources, which can then lead to poor wellbeing outcomes. Job resources support and

enable employee engagement and improve their performance. It may be the case that positive computing can play a role in the JD-R model in terms of understanding employee wellbeing as a job resource. Further research is needed to measure and assess the potential relationship between positive computing and the JD-R model, which would further add to the research on the role of positive computing in improving employee wellbeing.

Another model worth considering in relation to positive computing is the "technology acceptance model" (TAM) (Davis 1989). The TAM is one of the most commonly used theories to describe the process of technology adoption (Lee, Kozar & Larsen 2003, p. 752). It proposes "that perceived usefulness and ease of use" are the two mandatory factors that affect a person's intention to use a new technology. If an individual sees a new technology as being too difficult to learn, or not sufficiently useful to learn, they are less likely to engage with it. Davis (1989) adapted the "theory of reasoned action" (Ajzen & Fishbein 1980) to develop the TAM and it has since become a widely used and "powerful theory" (Lucas & Spitler 1999; Venkatesh & Davis 2000). Based on the research in this thesis, the role of positive computing and its manifestation in aged care suggest that the TAM may have a role to play in encouraging aged care staff to accept the need for new technology. The major variable of perceived usefulness may be understood in new ways where a positive computing lens is applied. If staff see that technology helps improve their wellbeing, then they may be quicker to accept the technology, promote its use and help with technology adoption.

A key issue that research into positive computing must address is the challenge of providing evidence of positive outcomes and benefits to wellbeing. Quantifying numerical measures for these outcomes can be difficult given the uniqueness of individuals and their health and wellbeing. Although this thesis answers the call to develop a scale for positive computing, it was limited and further studies, including longitudinal studies, need to be done to test the scale and measure the impact of positive computing on employee wellbeing in aged care and many other industries.

There remain considerable gaps in the research in positive computing and particularly in an aged care context, and this research offers a base for further research. Considering the role of positive computing in different organisational contexts, or in terms of different information technology theories, may allow further findings to emerge. The further testing and use of the quantitative scales will also help build robust measurable data in this field.

6.5 Implications for practice and policy

This thesis seeks to contribute to a small but growing area of research that requires further study: positive computing and using technology to enhance the wellbeing of employees. One of the key approaches in positive computing is to develop processes that have positive effects on the organisation and individual workers (Calvo & Peters 2014). The thesis also examined how the challenges of the aged care industry can be addressed. There are a number of implications for the field of aged care technology and employee wellbeing. First, the thesis provides evidence that positive computing can play a role in the diffusion of technology in aged care organisations by focusing on how technology can help perceived organisational support and promote wellbeing of staff and increase affective commitment and the potential to promote the adoption of technology more effectively. Rather than looking at the benefits of technology through the typical lens of efficiency, there should be a focus on the lens of staff wellbeing. By investing in technology aged care organisations can hope to retain staff as staff see the technology investment as an investment in them and that the organisation is supporting them. While the approach detailed in this research is based on one aged care organisation, to help overcome barriers within the aged care industry, the approach could be used more broadly across the aged care industry. In reviewing the aged care sector, the ACIITC (2017) made a number of value statements to guide the implementation of new technologies in the aged care sector. The ACIITC (2017, p. 6) suggests that the design of new technologies intended for the aged care sector must be designed, developed and evaluated with the contribution of the aged care workforce as end users. The ACIITC (2017, p. 16) also argues that the use of technologies must be incorporated into processes and policies of the sector as well as care practices themselves. Care workers are central in a network of stakeholders, including technology developers, aged care residents, their supporters, and researchers (ACIITC 2017, p. 46).

The final report of the Royal Commission into Aged Care Quality and Safety, released in early 2021, made a number of recommendations on staffing, the importance of aged care staff and training, pay and better working conditions. Recommendations made about technology and the role it plays which are relevant to this research are recommendations 13, 67, 81, 107, 108 and 109. These recommendations seek to invest in the technologies, equipment and digital infrastructure needed to meet the needs of the sector, to improve training and development of the aged care sector, improve the quality and safety standards in the sector, improve the use and exchange of data between the aged care and healthcare sectors, and increase funds capacity

in aged care facilities and the sector more broadly to improve innovation, research and data collection (Royal Commission into Aged Care Quality and Safety 2021).

Importantly the Commission recognised the importance of an adequately paid and trained aged care workforce (Royal Commission into Aged Care Quality and Safety 2021, p. 124), which supports the findings from this study as it recognises the importance of developing the aged care workforce into a profession and supports a key objective which Calvo and Peters (2015) proposed for positive computing of using technology for wellbeing and human potential. The Commission's report also makes clear the importance of professionalising the aged care sector and giving its workforce clear opportunities for development (Royal Commission into Aged Care Quality and Safety 2021, p. 125). Further research is required to see if positive computing has a place in the 'virtuous circle' suggested by the Royal Commission (Royal Commission into Aged Care Quality and Safety 2021, p. 125).

Technology maturity within the aged care system, particularly at the organisational level, has not been widely researched in Australia (Barnett et al. 2019). One recent study surveyed all 876 residential aged care facilities in NSW to determine the capabilities and levels of sophistication and integration of information (Barnett et al. 2019, p. 54) in both clinical support and residential care. It found that in 57% of facilities, no staff member was in an IT-related role (Alexander et al. 2019). The potential of positive computing requires further research into organisational readiness in the Australian context.

This study only briefly reviewed the report from the Royal Commission as it was released as this thesis was being finalised. There is sufficient evidence from the report's recommendations to explore further research opportunities on care staff and technology through the lens of positive computing to see if positive computing can play a role in ensuring the successful implementation by the Australian federal government of the Royal Commission's recommendations to improve care for older Australians.

6.6 Conclusion

The findings from both the quantitative and qualitative phases of this research against the four hypotheses and the research questions have been presented in this chapter. This research responds to the call in the literature to provide scales to quantitatively measure the impacts of positive computing and to conduct research into technologies that improve employee

wellbeing. Overall, the hypotheses on the impact of positive computing in an aged care organisation and on carers were supported. In contrast, the hypotheses of proactive care and was qualified in the quantitative study but were strongly supported in the qualitative study, which suggests that these hypotheses would be better explained by more detailed qualitative research. A potential fifth hypothesis started to evolve in the qualitative phase on how positive computing can support aged care staff in the diffusion of innovation in aged care organisations

Overall the study found evidence that considering technology through a positive computing lens can contribute to the wellbeing of care staff due to a perception of better organisational support, and helps to identify carers as instrumental in the diffusion of innovation. These findings echo those identified by the Australian Digital Health Agency (2018), which recognised the aged care workforce as critical in supporting the diffusion of innovation. The scale used in this thesis was a new contribution to knowledge.

This study had limitations in terms of its scope as it was a study in one organisation. Further analysis using other theoretical frameworks will help to better understand the potential of positive computing. There is scope to increase current public policy initiatives on the adoption of technology and to improve care and employee outcomes in the aged care industry. There are also implications for theory, future research and methods. Through its contributions, this research aims to be a catalyst for future research into positive computing.

Chapter 7: Conclusion

The main aim of this thesis has been to explore the manifestation of positive computing in an aged care context. To achieve this aim, this thesis addressed five research questions: 1) How does positive computing manifest in the context of aged care work? 2) To what extent does positive computing affect the work outcomes of aged carers? 3) To what extent does positive computing affect employee well-being 4) To what extent does positive computing affect the provision of aged care 5) How can positive computing promote diffusion of innovation in aged care organisations?

The study aimed to develop a new evidence-based framework to support researchers, technologists and aged care industry experts in the role that positive computing can play in the wellbeing of aged care workers. However, positive computing is not yet widely embedded in research on information systems and, consequently, there are calls to contribute more to this field of study (Pawlowski et al. 2015). This is, in part, because it diverges from traditional approaches to information technology research that primarily consider factors like workplace efficiency (Calvo & Peters 2014). A lack of evidence-based research presents a challenge to understanding the potential of positive computing in achieving positive wellbeing outcomes (Pawlowski et al. 2015). This study answered the calls for more research in positive computing made by Pawlowski et al. (2015) and by Calvo and Peters (2014).

The answers to the research questions emerged from an explanatory sequential mixed methods study of aged care workers at an a not-for-profit residential aged care organisation in Western Australia. A total of 148 carers responded to the survey and 36 of those carers then participated in interviews to discuss the results and further explore the themes from the quantitative survey. The discussions focused on positive computing, technology, wellbeing, perceived organisational support and the diffusion of innovation. As these are broad areas for research, it was important for analysis to ground them in a relevant context. An aged care setting was selected as a relevant context to ground this research.

As well as answering the research questions, this study also contributes to other views of technology and, in particular, discourses on the ways in which technology can be used to address some of the challenges facing the aged care industry. It also gave a voice to carers on the subject of technology and the role that carers can play in the sustainability of the aged care

industry. During interviews, great dedication was shown by the care workers, confirming the findings of the ACIITC (2019) report on the importance of aged care staff to the diffusion of innovation. The caring nature of these workers was evidenced by the priority they placed on the wellbeing and care of residents. This thesis emphasises and supports the recommendations of the ACIITC (2019) report and the need for endorsement and investment in the industry. While conducting this thesis research, the Royal Commission into Aged Care Quality and Safety commenced and then released its own findings in early 2021, many of which reinforce or support the findings of this thesis. While engaging with the Royal Commission was not part of the objectives of this thesis, the overlap between the Royal Commission's findings and those of this research adds more evidence to the recommendations made in the Royal Commission's final report (2021).

Carers do difficult and important work. Efforts have and continue to be made for carers to receive much-needed increases to their pay. Unfortunately, a significant pay rise in the sector is unlikely, in part due to the complexity of the industry and the limited funds available in the industry. As well as pay, other means are also required to support the enormous efforts of workers and to ensure the industry is more appealing to younger workers. The research findings in this thesis could assist aged care organisations and government to develop alternative approaches to improve the sustainability of the industry and job engagement for carers.

Positive computing research remains in its infancy. This thesis can stimulate other research in aged care and across other industries to address the potential positive computing has to improve employee wellbeing at work. This study had limitations. Firstly, research took place only within one large, multi-site aged care organisation. The findings in this research provided a research framework and a data set that can guide further research. In order to build further rigour into positive computing research, additional studies should be conducted in other aged care organisations and organisations operating in other industries.

Inherent in this study are professional and academic experiences that confirm how technology can and does play a role in employee wellbeing. Technology can make organisations happier places for employees and can improve levels of care in the aged care sector. Information technologies can transform or help resolve social and societal issues, including the many challenges facing the aged care industry. Aged care staff play an important role in society and it is hoped this thesis contributes to ensuring their work becomes less difficult.

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Appendix 1: Survey instrument

Q1. What is the name of the residential aged care facility that you work at?

_____

Q2. What is your gender?

❍ Female ❍ Male ❍ Other

Q3. What is your month and year of birth? _____ / _____
month / year

Q4.a. What is your position?

❍ Residential Aged Carer/ Personal Carer / AIN
❍ Other _____

Q4.b. Which of the following qualification do you possess?

❍ High school certificate
❍ Certificate III in _____
❍ Certificate IV in _____
❍ Bachelor degree in _____
❍ Other _____

Q5. For how long have you been a member of this organisation?

❍ Less than 6 months
❍ 6 months to 2 years
❍ 2 to 5 years
❍ 5 to 10 years
❍ more than 10 years

Q5.b. What is your employment type?

❍ Full-time
❍ Part-time
❍ Casual

Q6. Is English your first language?

❍ Yes ❍ No

Q7. Would you identify yourself as being a migrant? (i.e. have you moved to Australia after being born, and living in another country)

❍ Yes ❍ No, please skip Q8.

Q8. From which country did you migrate from prior to coming to Australia?

_____

Q9. On a typical shift, approximately how many residents do you provide direct care to?

_____ residents

Q10. Of the residents you care for, approximately what percentage are classified as PAS (psychological assessment scale) over 4?

_____ out of _____ residents

(number with PAS above 4) (total number that you care for)

On the following scales, please circle your level of agreement with the following questions.

(please note: SD = strongly disagree, D = disagree, slD = slightly disagree, slA = slightly agree, A = agree, SA = strongly agree)

The organisation that I work for…	SD	D	Sid	SiA	A	SA
cares about my opinion						
cares about my well-being						
considers my goals and values						
provides help for me when I have a problem						
would forgive an honest mistake on my part						
would not take advantage of me						
is willing to help me if I need a special favour						

My manager…	SD	D	SiD	SiA	A	SA
is satisfied with my work						
understands my work problems and needs						
recognises my potential						
is willing to use their power to help me solve problems						
would be willing to 'bail me out' at her / his own expense						
and I share similar values, beliefs and practices						
I have a good working relationship with my manager						
I would defend my manager if they were not present						

Well-being	SD	D	SiD	SiA	A	SA
Overall, I am reasonably happy with my work life						
Overall, I fulfill an important purpose in the work that I do						
Most days I feel a sense of accomplishment from my work						
I get enough time to reflect on what I do in the workplace						

Intention to leave	SD	D	Sid	Sia	A	SA
I frequently think about leaving this organisation						
It is likely that I would search for a job in another organisation						
It is likely that I would actually leave my current organisation within the next year						

I feel confident in…	SD	D	SiD	SiA	A	SA
representing my work area in meetings with management						
contributing to discussions about my workplace's strategy						
helping to set targets or goals in my work area						
contacting people outside of my workplace to discuss problems						
presenting information to a group of colleagues						
Hope						
If I find myself in a jam at work, I could think of many ways to get out of it						
Right now I see myself as being pretty successful at work						
I can think of many ways to reach my current work goals						
At this time, I am meeting the goals that I have set for myself						
When I have a setback at work, I don't have any trouble recovering						

Resilience	**SD**	**D**	**SiD**	**SiA**	**A**	**SA**
I can bounce back quickly when things go wrong at work						
I usually manage difficulties, one way or another						
I can be on my own, so to speak, at work if I have to						
I usually take stressful things in my stride						
I can get through difficult times at work because I've experienced difficulty before						

Optimism	SD	D	SiD	SiA	A	SA
When things are uncertain for me at work, I usually expect the best						
I always look on the bright side of things regarding my job						
I'm optimistic about what will happen to me in the future at work						
In this job, things always work out the way I want them to						
I approach this job as if "every cloud has a silver lining"						

Employee Engagement	SD	D	SiD	SiA	A	SA
At work, I am bursting with energy						
I find the work that I do very meaningful						
Time flies when I'm working						
When I get up in the morning, I feel like going to work						
I am enthusiastic about my job						
I persevere, even when things do not go well						
I am proud of the work that I do						
I feel happy when I am working intensely						

Resource Adequacy	SD	D	SiD	SiA	A	SA
There are enough staff to get the work done						
There are enough trained staff to ensure quality of care for residents						
There is enough support to allow me to spend sufficient time with residents under my care						
I have enough time and opportunity to discuss resident care problems with other staff						

The following set of three questions asks you to reflect on the residents you care for and give information about the instances of:

i) *pressure injuries (e.g. bed sores),*
ii) *sudden, unexplained weight-loss, and*
iii) *behaviour changes necessitating the use of restrains*

The three question sets appear very similar; however, it is important that you respond to each one separately. All three sets of data are essential to provide adequate analysis.

25. Quality Indicators

Thinking back over the last three months, approximately what percentage of the residents that I care for* have presented with…

**do not include new residents where symptoms were present on arrival*

Pressure Injuries (e.g. bed sores or ulcer):

❍ 0%|❍ 10% |❍ 20%|❍ 30% | ❍ 40%|❍ 50% |❍ 60%|❍ 70% |❍ 80% |❍ 90% | ❍ 100%

Sudden, unexplained weight loss (more than 3kgs):

❍ 0%|❍ 10% |❍ 20%|❍ 30% | ❍ 40%|❍ 50% |❍ 60%|❍ 70% |❍ 80% |❍ 90% | ❍ 100%

Erratic change of behaviour:

❍ 0%|❍ 10% |❍ 20%|❍ 30% | ❍ 40%|❍ 50% |❍ 60%|❍ 70% |❍ 80% |❍ 90% | ❍ 100%

The need to use physical restraints:

❍ 0%|❍ 10% |❍ 20%|❍ 30% | ❍ 40%|❍ 50% |❍ 60%|❍ 70% |❍ 80% |❍ 90% | ❍ 100%

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26. On the following scale, please circle the level of frequency that the following occurs…

(please note: 1 = Never, 2 = not often, 3 = less than half of the time, 4 = more than half of the time, 5 = often, 6 = always)

Over the last three months, how frequently have you observed the following conditions in the residents you care for* **do not include new residents where symptoms were present on arrival*	Never	irregularly	Not often	often	regularly	Always
Pressure Injuries (e.g. Bed sores or ulcers)	1	2	3	4	5	6
Sudden, unexplained weight-loss (more than 3kgs)	1	2	3	4	5	6
Erratic change of behaviour	1	2	3	4	5	6
The need to use physical restraints	1	2	3	4	5	6

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27. With respect to the number of residents you are caring* for currently, how many of them are currently presenting with the following conditions:

**do not include new residents where symptoms were present on arrival*

Pressure injuries*:

_____ out of _____ residents

(number with pressure injuries) (total number that you care for)

Sudden, unexplained weight-loss* (more than 3kgs):

_____ out of _____ residents

(number with unexplained weight-loss) (total number that you care for)

Erratic change of behaviour*:

_____ out of _____ residents

(number with behaviour change) (total number that you care for)

Use of physical restraints*:

_____ out of _____ residents

(number with physical restrains) (total number that you care for)

On the following scale, please circle your level of agreement with the following questions.
please note: SD = strongly disagree, D = disagree, slD = slightly disagree, slA = slightly agree, A = agree, SA = strongly agree)

Teamwork

The people I directly work with…	SD	D	siD	siA	A	SA
resolve disagreements cooperatively						
are cooperative and considerate						
constructively confront problems						
are concerned about each other						

Managerialism	SD	S	SiD	SiA	A	SA
The organisation that I work for sets unrealistic targets						
I experience excessive work monitoring at work						
I am given meaningless tasks at work						
I decide how I do my job						
I can decide on my own how to go about doing my work						
I have opportunities for independence and freedom in how I do my job						

Affective Commitment	SD	D	siD	siA	A	SA
I would be very happy to spend the rest of my career with this organisation						
This organisation has a great deal of personal meaning for me						
I enjoy discussing my organisation with people outside it						
I feel emotionally attached to this organisation						
I feel a strong sense of belonging to this organisation						
I feel strong ties with this organisation						

23. Safety Participation	SD	D	siD	slA	A	SA
I use all of the necessary safety equipment to do my job	SD	D	slD	slA	A	SA
I use the correct safety procedures for carrying out my job	SD	D	slD	slA	A	SA
I ensure the highest levels of safety when I carry out my job	SD	D	slD	slA	A	SA
I promote a sense of being safety conscious to my colleagues	SD	D	slD	slA	A	SA
I put in extra effort to improve the safety of the workplace	SD	D	slD	slA	A	SA
I voluntarily carry out tasks or activities that help to improve workplace safety	SD	D	slD	slA	A	SA

24. Proactive care	SD	D	SiD	SiA	A	SA
I am able to recognise health problems in the residents that I care for						
I closely monitor any changes in the physical weight of residents						
I know what to do when I suspect a resident has a pressure injury						
I can generally identify who is likely to get a pressure injury, and monitor them accordingly						
I am good at preventing injuries or infection in residents						
Residents under my care get the best quality health experience						
I am easily able to mobilise, move, and lift residents when necessary						
I consider it my responsibility to keep residents happy						
I consider it my responsibility to keep residents entertained						
I encourage residents to be socially active						
I consider it my responsibility to keep residents healthy						

28. The following things cause stress for me at work…	SD	D	siD	siA	A	SA
Traumatic events (e.g. death of the person I am caring for, injury)						
Paperwork						
Dealing with co-workers						
The feeling that different rules apply to different people (e.g. favoritism)						
Staff shortages						
Too much computer work						
Lack of resources						
Unequal sharing of work loads						
Having to deal with lots of residents with dementia						
Inadequate equipment						
Lack of support for dealing with difficult residents						
Depressing work environments						
My clients are frustrated most of the time and are difficult to deal with						

Utility of Technology in Aged Care Work

What percentage of your job currently involves using computers to do your work? For example a patient record system, a patient monitoring system?

❍ 0%|❍ 10% |❍ 20%|❍ 30% | ❍ 40%|❍ 50% |❍ 60%|❍ 70% |❍ 80% |❍ 90% | ❍ 100%

What percentage of your job currently involves the use of digital technologies that are not computers (i.e. monitors, digital moving aids)?

❍ 0%|❍ 10% |❍ 20%|❍ 30% | ❍ 40%|❍ 50% |❍ 60%|❍ 70% |❍ 80% |❍ 90% | ❍ 100%

In your own opinion, how technologically advanced is this organisation on a scale of 1 (not at all) to 10 (completely).

1 2 3 4 5 6 7 8 9 10

On the following scale rate how helpful this technology is in enabling your job on a scale of 1 (not at all) to 10 (completely).

1 2 3 4 5 6 7 8 9 10

Technology and Care

On the following scales, please circle your level of agreement with the following questions.

(Please note: SD = strongly disagree, D = disagree, slD = slightly disagree, slA = slightly agree, A = agree, SA = strongly agree)

Technology at work	SD	D	SiD	SiA	A	SA
It is easy to use digital technology in my work						
I can effectively complete my work using the available digital technology						
The technology available in my work is easy to learn						
I have become more productive using digital technology in my work						
Whenever I make a mistake using the technology in my work I can recover quickly and easily						
I can better care for the residents under my care with the available digital technology in my work						
Using Digital Technology at work makes me feel like I am always on the job						
Using Digital Technology reduces my fatigue level at work						
The Digital technology at my organization reduces the amount of bureaucratic red tape and administration work						
Digital technology helps me get my work done when there are staff shortages						
Using Digital Technology at work increases my level of satisfaction with my work						
Digital Technology in my work makes me feel very connected to the people in my organization						
Using Digital Technology in my work helps me identify problems at work and resolve them						
Using digital technology enables me to make judgments on my own work and perform tasks without instructions from superiors						
Digital Technology in my work helps me listen to resident's complaints or wishes and respond/cope appropriately						
Digital Technology in my work helps me decide how to care for residents according to my own judgement as a carer						
Digital Technology in my work helps to remind me that my work is meaningful and purposeful						
We have meetings to discuss ways we can innovate and use technology better						
Managers possess the appropriate leadership qualities to support digital technology use						
The training I receive is directed at helping me deliver better care using digital technologies						

Organisational Constituency

On the following scales, please circle your level of agreement with the following questions.

(please note: SD = strongly disagree, D = disagree, slD = slightly disagree, slA = slightly agree, A = agree, SA = strongly agree)

Organisational Constituency Innovation	SD	D	SiD	SiA	A	SA
My contributions to innovative digital technology are valued by my fellow employees						
I understand how I can contribute to innovation of in my organisation						
There is trust and mutual respect currently between management and employees						
I am sufficiently engaged in my organisation's strategic planning process						
Communication in my organisation is open and honest						
My organisation has an effective environment for collaboration						
I feel enabled to generate ideas						
I am connected to an innovation movement in this organisation						
I would be happy to help create the digital technology future for this organisation						
I am encouraged to challenge decisions and actions for this organisation if I think there is a better way						
I feel that I am trusted to act in the organisation's best interests with minimal supervision						
I am rewarded for being innovative						

What Digital Technologies would help you do your job more effectively?

Please feel free to share your opinions about the contents of this survey if you would like to:

Appendix 2: Ethics approval

The Human Research Ethics Committee of the University of Technology Sydney reviewed and approved the research phase of this study (UTS HREC 16-0671)