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What Impact do Smartphones have on Technostress?

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Abstract

The advancement of ICTs throughout recent decades has provided easy and rapid access to information, improved communications, performance gains, productivity gains, and a whole host of other benefits (Riedl 2013). However, this advancement comes with a “darker side” known as technostress (Walz 2012), which has increased in frequency since the early 1990’s.

Technostress, which is the stress that one suffers from as a direct or indirect result of technology, has been shown to cause a wide range of both psychological and physiological symptoms, resulting in reduced productivity, reduced job satisfaction, exhaustion, and commitment issues (Tarafdar et al. 2007). While technostress is a widely researched area, there is a lack of research that has identified specific technologies and the impacts that they have on technostress.

This study has investigated the impact that smartphones have on technostress. This has been achieved with an online survey of 143 individuals of mixed demographics via social media, both by measuring direct smartphone technostress, as well as the impact that this has on general technostress. The Rosen and Weil GATCS instrument has been used to measure general technostress, along with a newly developed smartphone questionnaire that is based on the five components of technostress developed by Tarafdar et al. (2007).

The findings from the GATCS instrument indicate that over 35% of respondents suffer from technostress. The study has also shown that smartphones are causing their own form of technostress, with techno-overload and techno-complexity being the most common stressors. Smartphone technostress has also been found to moderately correlate to general technostress, suggesting a relationship between the two. This indicates that further research is needed in this area.
Acknowledgements

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# Table of Contents

1 **Introduction** ............................................................................................................. 8  
1.1 Project Rationale ....................................................................................................... 8  
1.2 Research Question, Aims and Objectives ................................................................ 9  
  1.2.1 Research Question ............................................................................................. 9  
  1.2.2 Aims .................................................................................................................... 9  
  1.2.3 Objectives ............................................................................................................ 9  
2 **Literature Review** .................................................................................................... 10  
  2.1 Introduction .............................................................................................................. 10  
  2.2 Stress ...................................................................................................................... 10  
    2.2.1 Defining Stress .................................................................................................. 11  
  2.3 Technostress .......................................................................................................... 12  
    2.3.1 What is Technostress? ....................................................................................... 12  
    2.3.2 The Strains of Technostress ............................................................................. 13  
    2.3.3 Measuring Technostress ................................................................................... 14  
      2.3.3.1 *Trends over Time* .................................................................................... 15  
      2.3.3.2 *Technostress Demographics* .................................................................. 16  
    2.3.4 The Five Components of Technostress ......................................................... 17  
      2.3.4.1 *Techno-overload* .................................................................................... 18  
      2.3.4.2 *Techno-invasion* ..................................................................................... 19  
      2.3.4.3 *Techno-complexity* ................................................................................ 20  
      2.3.4.4 *Techno-insecurity* ................................................................................... 20  
      2.3.4.5 *Techno-uncertainty* ............................................................................... 21  
      2.3.4.6 *Limitations of the Model* ....................................................................... 22  
    2.3.5 Technostress and the Advancement of Technology ........................................ 22  
      2.3.5.1 *An Advancing Technology: Smartphones* ........................................... 23  
      2.3.5.2 *Smartphones and Technostress* ............................................................. 24  
  2.4 Conclusions ............................................................................................................ 25  
    2.4.1 Key Issues ....................................................................................................... 25  
    2.4.2 Refined Research Question ............................................................................. 26  
3 **Research Methodology** ......................................................................................... 27  
  3.1 Introduction ............................................................................................................ 27  
  3.2 Research Strategy .................................................................................................. 27
4 Findings and Analysis ........................................................................................................... 34

4.1 Introduction ......................................................................................................................... 34

4.2 Analysis ................................................................................................................................. 34

4.2.1 Response Rate .................................................................................................................. 34

4.2.2 Demographics .................................................................................................................. 35

4.2.2.1 Age Groups ................................................................................................................ 35

4.2.2.2 Gender ........................................................................................................................ 36

4.2.2.3 Smartphone Types ..................................................................................................... 37

4.2.3 GATCS Technostress Findings ....................................................................................... 38

4.2.3.1 GATCS Score Overall ............................................................................................... 38

4.2.3.2 GATCS Score by Gender .......................................................................................... 39

4.2.3.3 GATCS Score by Age Groups ................................................................................ 40

4.2.3.4 GATCS Score by Smartphone/Non-Smartphone Owners ....................................... 41

4.2.4 Smartphone Technostress ............................................................................................. 42

4.2.4.1 Smartphone Technostress Overall ............................................................................ 42
4.2.4.2 Smartphone Technostress by Smartphone Type ........................................ 44
4.2.4.3 Smartphone Technostress by Gender ......................................................... 45
4.2.4.4 Smartphone Technostress by Age Group .................................................. 46
4.2.5 GATCS and Smartphone Technostress Correlations ...................................... 47
  4.2.5.1 GATCS and Smartphone Technostress Correlation .................................... 47
  4.2.5.2 GATCS and Smartphone Technostress Correlation by Technostress Component .............................................................................................................. 49
  4.2.5.3 GATCS and Smartphone Technostress Correlation (smartphone averages) .... 51
4.3 Key Findings ...................................................................................................... 52
4.4 Conclusions ...................................................................................................... 52

5 Discussion ............................................................................................................ 54

5.1 Introduction ....................................................................................................... 54
5.2 General Technostress ....................................................................................... 54
  5.2.1 Current Levels of Technostress ................................................................. 54
  5.2.2 Technostress by Demographic Groups ..................................................... 55
5.3 Smartphone Technostress ................................................................................ 56
5.4 Is Smartphone Technostress Linked to General Technostress? ....................... 57
5.5 Conclusions ...................................................................................................... 58

6 Conclusions and Recommendations ..................................................................... 59

6.1 Conclusions ...................................................................................................... 59
6.2 Recommendations ............................................................................................ 60
  6.2.1 Recommendations for Organisations ....................................................... 60
  6.2.2 Further Research ....................................................................................... 60

7 Personal Reflection .................................................................................................. 62

7.1 What I Would do Differently Next Time .......................................................... 62

8 Bibliography ......................................................................................................... 63

9 Appendices ........................................................................................................... 67
List of Tables

Table 2.1: The Five Components of Technostress................................................................. 17
Table 3.1: GATCS Scoring.................................................................................................. 29
Table 3.2: Smartphone Questions....................................................................................... 30
List of Figures

Figure 2.1: The Impact of Technostress on Role Stress and Productivity ........................................ 13
Figure 2.2: Technostress Trends over Time .................................................................................... 15
Figure 4.1: Demographics: Age Groups .......................................................................................... 35
Figure 4.2: Demographics: Gender ................................................................................................. 36
Figure 4.3: Demographics: Smartphone Types ................................................................................ 37
Figure 4.4: GATCS Score Overall ................................................................................................... 38
Figure 4.5: GATCS Score by Gender ............................................................................................... 39
Figure 4.6: GATCS Score by Age Groups ....................................................................................... 40
Figure 4.7: GATCS Score by Smartphone/Non-Smartphone Owners ............................................. 41
Figure 4.8: Smartphone Technostress Overall ............................................................................... 42
Figure 4.9: Smartphone Technostress by Smartphone Type ........................................................... 44
Figure 4.10: Smartphone Technostress by Gender ......................................................................... 45
Figure 4.11: Smartphone Technostress by Age Group ................................................................. 46
Figure 4.12: GATCS and Smartphone Technostress Correlation .................................................. 47
Figure 4.13: GATCS and Smartphone Technostress Correlation by Technostress Component 49
Figure 4.14: GATCS and Smartphone Technostress Correlation (smartphone averages) ....... 51
Figure 5.1: Technostress Trends over Time (with current study) .................................................. 55
1 Introduction

1.1 Project Rationale
The advancement of ICT in recent decades has provided organisations with improved communications, easy and rapid access to information, and performance and productivity gains (Riedl 2013).

While there are many benefits that go along with the introduction of new technologies, there is also a “darker side” known as technostress (Walz 2012). Technostress has been defined as the stress that one suffers from as a direct or indirect result of the use of technology (Rosen and Weil 1997, p5).

One issue is that the majority of ICT research has focused on what benefits can be gained from ICT, rather than what potential negative effects it can bring, and it is essential for any organisation to consider the impact of these negative effects (Ayyagari et al. 2011).

As with stress itself, technostress has been proven to have a negative correlation with an individual’s productivity (Tarafdar et al. 2007), and is therefore a critical issue that should be considered when an organisation adopts new technologies.

Technostress research conducted over the past few decades has shown that it is a growing area of concern, especially as the world of ICT is becoming ever more advanced, complex, and fundamental to organisations in a competitive marketplace (Barley et al. 2011).

The advancement of technologies such as cloud and distributed computing are pushing more and more organisations to structure themselves in distributed teams that collaborate via the internet (Barley et al. 2011), and organisations are becoming ever more dependent on the use of technology.

It is often argued that technological advancements within organisations far outpace the organisation’s understanding of health and safety, as well as the quality of work life that is associated with these changes (Schellhammer et al. 2013). ICTs are also encouraging many organisations to place work demands on individuals that exceed their abilities (Tu et al. 2005).

As technology is becoming more prevalent, and technostress is causing individuals to become less productive, it is vital that the issue of technostress is addressed. The UK Companies Act
2006 (GOV.UK 2006) states that a director of a company must act in all of his/her power to ensure the long term interests of the company and its employees, which involves overseeing any factor that includes fair conduct, sustainability, and company reputation amongst others. It is vital for any director to consider the effects of technostress on these factors.

This study will investigate the phenomenon of technostress, its effects on both individuals and organisations, and identify specific causes and what can be done to mitigate them.

1.2 Research Question, Aims and Objectives

1.2.1 Research Question
What impact does a specific technology have on technostress?

1.2.2 Aims
The project aim is to measure current levels of technostress, identify a specific technology that is contributing to the issue, and recommend future steps towards addressing the causes.

1.2.3 Objectives
The project aim will be achieved by completing the following objectives:

- Research current literature on technostress, including trends over time, current levels, identified causes, and future recommendations.
- Identify the advancements of technology and the effects that a specific technology could be having on technostress.
- Measure levels of technostress within a given sample group, and measure the impact of the identified technology on this.
- Recommend specific steps to be taken in order to mitigate or further investigate some of the identified causes of technostress.
2 Literature Review

2.1 Introduction

The advancements of technology seen over recent decades have empowered organisations to boost productivity, increase communications, and provide a wealth of information at the push of a button (Riedl 2013). While there are many benefits to the advancements of technology, there is also a ‘darker side’ to adopting them which can result in negative outcomes (Walz 2012).

Technology itself can create uncertainty, pressure and other undesirable effects in the individuals who use it. This can lead to a type of stress known as ‘technostress’, a term coined by Craig Brod in 1984, who described it as “a modern disease caused by the inability to cope or deal with ICT” (Ayyagari et al. 2011).

This literature review will focus on technostress, its causes and effects from both an individual and organisational perspective, and the effects that certain technological advancements have on technostress, productivity, and organisations as a whole.

2.2 Stress

Stress and the effects of stress are a fact of everyday life that everybody deals with to at least some extent (Serva et al. 2011).

It is vitally important to consider the causes and effects of stress, both from an individual perspective as well as from an organisation’s perspective, especially as stress in the workplace (role stress) has a negative effect on productivity (Weiss 1983); (Tarafdar et al. 2007); (Serva et al. 2011).

Stress can have many different causes, some of which include role conflict, where an individual is required to fulfil multiple roles that may produce contradicting interests (Tarafdar et al. 2007), role overload, where excessive demands are placed on an individual, (Ragu-Nathan et al. 2008); (Tarafdar et al. 2007), lack of feedback, role ambiguity, and the pressures of keeping up with rapid technological change (Weiss 1983); (Serva et al. 2011). Other causes can include job insecurity, work-home conflict, and invasion of privacy (Ayyagari et al. 2011).

These examples highlight just a few causes of stress experienced in the workplace. There are indeed many different causes of stress and many different contexts that stress is experienced in.
Serva et al. (2011) describe two different manifestations of stress - a physiological (inner) stress, which describes the physical autonomic reaction of the body (e.g. heart rate and breathing), and a psychosocial (outer) stress, which describes how an individual perceives and chooses to respond to the psychosocial aspects of stress.

Stress, in other words, is a very complex and serious condition that can result in negative outcomes, including both undesirable symptoms and an overall reduction of productivity.

Tarafdar et al. (2007) showed in a study on 233 public-sector employees that two types of role stress (role conflict and role overload) were inversely related to productivity, as well as leading to poor job performance, lack of motivation, and job dissatisfaction.

2.2.1 Defining Stress

Before investigating technostress, it is important to define ‘stress’ itself. While existing literature provides many different definitions of stress, common themes can be found, with most definitions consisting of a strain, which are the effects that the individual experiences, and a stressor which is the cause of the stress. Aamodt (1999) describes stress as:

“The psychological and physical reaction to certain events or situations (called stressors) in your life” (Aamodt 1999 p.569).

This simple definition can be broken down into two parts:

- Strain (“the psychological and physical reaction”)
- Stressor (“certain events or situations”)

While this provides a general and high-level definition of stress, more specific definitions can be found, such as Tarafdar et al. (2007) who describe stress as:

“When a person experiences an inability to fulfil multiple, possibly conflicting, responsibilities or to deal with the level of difficulty and complexity of tasks on hand. This frustration often translates into physical illness, fatigue, and mental disorders that eventually lead to excessive absenteeism, turnover, and decreased performance on the job.” (Tarafdar et al. 2007).

This definition is more specific, listing several distinct symptoms and causes. It can however be linked to the previous definition by being split into two parts in the same way:
● Strain ("physical illness, fatigue, and mental disorders" etc.)

● Stressor ("an inability to fulfil multiple, possibly conflicting, responsibilities" etc.)

These examples demonstrate that stress consists of two major elements: a strain and a stressor.

2.3 Technostress

2.3.1 What is Technostress?

As previously demonstrated, ‘stress’ can be any number of negative psychological or physiological strain that an individual suffers from as a result of a stressor.

The concept of an individual suffering from symptoms of stress as result of technology has fallen under many labels, including ‘technostress’, ‘technophobia’, ‘cyberphobia’, ‘computerphobia’, ‘computer anxiety’, ‘computer stress’, ‘negative computer attitudes’, and many more (Shu et al. 2008). The term ‘Technostress’ was originally coined by a clinical psychologist named Craig Brod in 1984, who described it as:

“A modern disease caused by the inability to cope or deal with ICT” (Ayyagari et al. 2011).

An extended version of Brod’s original definition is given by Rosen and Weil (1997, p.5):

“Any negative impact on attitudes, thought, behaviours, or body physiology that is caused either directly or indirectly by technology”

As the term ‘stress’ has previously been defined as having two major elements - strain and stressor, the same can be applied to the term ‘technostress’.

The first part of the definition (“any negative impact on attitudes, thought, behaviours, or body physiology”), describes the strain, and the second half of the definition (“that is caused either directly or indirectly by technology”) describes the stressor. It is the stressor that qualifies this particular type of stress as technostress.

To conclude, technostress can be defined as any type of stress that an individual suffers from as a direct or indirect result of technology.
2.3.2 The Strains of Technostress

Technostress is not limited to just a symptom, or set of symptoms that an individual suffers from. Much like stress itself, technostress can have a major impact on an individual, his/her productivity and position within the workplace, and the organisation as a whole.

Based on a study of 233 public-sector employees, Tarafdar et al. (2007) showed that technostress not only has a direct negative correlation with productivity, but also has an impact on role stress (which was also shown to have a negative correlation with productivity).

The authors argue that technology is intimately linked with one’s role, and can even change the hierarchy within an organisation. As a result, technostress has a major impact not only on the productivity of an individual, but of the organisation as a whole. Figure 2.1 illustrates the relationship between technostress, role-stress, and productivity:

![Figure 2.1: The Impact of Technostress on Role Stress and Productivity (Tarafdar et al. 2007)](image)

The argument made by Tarafdar et al. (2007) on the relationship between technostress and role stress is very important, as it shows that technostress is not just an anomaly that stands on its own with regards to technology, but is in fact intimately linked with other aspects of stress, the workplace, and the individual’s role within the organisation.

Technostress studies have not only shown it to have a negative correlation with productivity, it also greatly reduces job satisfaction (Tarafdar et al. 2007); (Shu et al. 2008); (Tarafdar et al. 2011); (Ayyagari et al. 2011); (Walz 2012), as well as causing work exhaustion and organizational commitment issues (Ahuja et al. 2007). Self and Aquilina (2012) argue that parts of the population are at risk of becoming disenfranchised if they are unwilling or unable to
engage with technology, while Shu et al. (2011) showed that technostress can result in physiological symptoms, including hypertension, migraines, and heart problems.

Thomée et al. (2007) also argue that prolonged technology-induced stress in the workplace can have a serious impact on the psychological health of an individual.

Technostress can also have an effect on the education sector. Rosen and Weil (1992) found in a study on Californian schoolteachers that many were not utilising computers in the classroom due to technostress, and Weil et al. (1990) describe the importance of the introducer, as low confidence levels can be passed on to students.

An individual’s confidence levels have also been shown to have an impact on technostress. Shu et al. (2011) found in a study of 305 employees from 22 organisations that there is a negative correlation between technostress and self-efficacy. The study also showed that technology dependence was also a good predictor of technostress, suggesting that if users have no alternatives, and are therefore ‘forced’ to use a technology, they are more likely to suffer from stress as a result. These findings are not unique; Tarafdar et al (2011) found that 80% of 233 respondents felt higher technostress levels due to technology use in the workplace, with a clear correlation between technostress levels and self-efficacy, confirming the findings by Shu et al. (2011).

2.3.3 Measuring Technostress
In order to measure technostress, certain challenges need to be overcome. There could for example be difficulties in finding an unbiased sample group, as those who are more prone to technostress could be less likely to complete a voluntary (often computer based) survey. Studies such as Ahmad and Amin (2012) have used an online survey which was voluntarily completed. Similarly, respondents may not give an accurate description of how they actually feel, as stress can produce subjective, as well as objective symptoms (Lundberg 2006).

As well as being extremely prevalent, technostress can also be elusive and difficult to identify. Rosen and Weil (1992) argue that many people who suffer from moderate levels of technostress may not even be aware of it.
2.3.3.1 Trends over Time

Studies that have measured technostress have been spread out, both in terms of geographical location and demographics. For example, Ayyagari et al. (2011) and Tarafdar et al. (2007) focus on working professionals from mixed organisations, whereas studies such as Self & Aquilina (2012) and Walz (2012) focus on individuals within specific organisations. There has not been a continuous and consistent study that provides an accurate and comprehensive picture of the changing levels of technostress covering the past few decades. While this may be true, there have been a number of studies which can be used to gain at least some understanding about trends over time. Figure 2.2 shows a sample of studies covering the past two decades that indicate the percentage of respondents within each study that suffer from either low, moderate, or high levels of technostress, technophobia, or technology related anxiety:

![Technostress Trends](image)

Figure 2.2: Technostress Trends over Time

As can be seen by the given sample of studies, technostress levels have been increasing on average since the early 1990’s, with the sampled studies showing a correlation coefficient of $r = \ldots$
For this reason, it is important to investigate the different types of technostress, what causes technostress, and what can be done to help improve the situation.

### 2.3.3.2 Technostress Demographics

While computer anxiety has been proven to reach levels which conform to DSM-IV criteria for an actual phobia (Thorpe and Brosnan 2007), studies on technostress conducted throughout the past three decades have shown it can appear in virtually any individual.

Studies including (Rosen and Maguire 1990); (Rosen and Weil 1992); (Rosen and Weil 1995); (Clute 1998); (Tarafdar et al. 2007); (Weng et al. 2008); (Self and Aquilina 2012); and (Ahmad and Amin 2012) (to name but a few), have shown a high frequency of technostress in a wide range of demographics.

Technostress has been shown to be prevalent amongst working professionals in many different organisations. Rosen and Weil (1992) found in a study on Californian schoolteachers that 44% suffered from at least some level of technostress, with 17% suffering from high levels of technostress (an increase from 35% in a previous study by the same research group). Self and Aquilina (2012) also found that 58% of respondents in a study of 116 Malta government employees showed some degree of technostress, with 19% suffering from moderate to high levels. Walz (2012) found high levels amongst retail employees, while Shu et al. (2008), showed in a study of 951 employees from multiple organisations that over 75% of managers felt increased stress and workloads due to technology in the workplace. The study also found that technostress levels were higher in organisations that were highly innovative, adopted new technology, and had a highly centralized power structure. The employees also showed lower technostress levels if they were more involved with projects.

Technostress has been found in many different nations around the globe. Studies including Lee et al. (2012), Self and Aquilina (2012), Rosen and Weil (1992), Clute (1998), Tarafdar et al. (2007), Shu et al. (2008) have shown high levels of technostress in China, Malta, USA, and South Korea amongst others.

Some studies have identified differences in technostress between men and women, including Tarafdar et al. (2007) who showed that men had higher levels of technostress than women in many circumstances, although the men also chose to use technology more frequently than the
women. The study also showed that older and more experienced users showed lower technostress levels than younger and less experienced users.

2.3.4 The Five Components of Technostress

Although Technostress is a broad research area, it is lacking in studies that have identified specific technologies that cause technostress (Ayyagari et al. 2011). Recent literature does however describe five different technostress components originally proposed by Tarafdar et al. (2007) that can affect an individual in the workplace. Each of the five components can be thought of as a category, or type of technostress cause (rather than a specific cause).

Based on a study on 233 public-sector employees, Tarafdar et al. (2007) showed that these five components had both a direct, and indirect (via role stress) negative impact on the productivity of an individual in the workplace. The five components have since become a common basis for technostress research (Walz 2012), and although they are often described in varied ways, amount to the same basic principles. Table 2.1 summarises the five components as described by Tarafdar et al. (2007); Shu et al. (2008); Tarafdar et al. (2011); Ahmad & Amin (2012); and Walz (2012).

<table>
<thead>
<tr>
<th>Technostress Component</th>
<th>Description</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Techno-overload</td>
<td>When an individual is forced to work at higher speeds, and for longer hours because of technology</td>
<td>Too Much</td>
</tr>
<tr>
<td>Techno-invasion</td>
<td>When an individual can be contacted at any time, and the boundary between work and personal hours becomes less distinct</td>
<td>Always Connected</td>
</tr>
<tr>
<td>Techno-complexity</td>
<td>When an individual feels that their skills are insufficient due to difficult ICT and must spend time trying to understand it</td>
<td>Difficult</td>
</tr>
<tr>
<td>Techno-insecurity</td>
<td>When an individual feels that their job is threatened by ICT or someone else that is better at using ICT than them</td>
<td>Uncomfortable</td>
</tr>
<tr>
<td>Techno-uncertainty</td>
<td>When an individual is hesitant/disturbed as technology is always changing/upgrading</td>
<td>Too Often and Unfamiliar</td>
</tr>
</tbody>
</table>

*Table 2.1: The Five Components of Technostress*
2.3.4.1 Techno-overload

‘Techno-overload’ describes a context in which an individual is overwhelmed with demands that are placed on them through multiple ICT channels (Tarafdar et al. 2007); (Walz 2012). Struggling or failing to keep up with these demands causes a type of technostress known as ‘techno-overload’, ‘information fatigue’, or ‘information overload’.

Ahmad (2012) found in a study on 162 Malaysian librarians that techno-overload was the second most common cause of technostress (behind techno-uncertainty), meaning that it is important for employees to properly manage adequate time for employee training when a new technology is introduced, as studies have shown that individuals have a maximum level of information processing, with an optimal level when the complexity is moderate (Paul and Nazareth 2010).

An example of a common effect that techno-overload can have is an individual leaving unopened emails in their inbox (Whittaker 2005), which is obviously counter-productive, and could have serious implications for an individual in the workplace.

Barley et al. (2011) found that workers from three different organisations actually had an increased average workday length when a high quantity of emails were received, and that 45% of workers suffered from at least some form of anxiety about failing to manage the inflow of emails, as well as missing important emails. This lead to 75% of them disabling inbox spam filters (which are themselves designed to reduce the inflow of unwanted email), potentially worsening the issue. The study also found that increased overall time spent handling emails lead to higher average levels of techno-overload.

While a constant barrage of tasks (e.g. answering emails) may be a cause of techno-overload, it is not necessarily as simple as measuring the quantity alone. For instance, Bellotti et al. (2005) argue that “email overload” is not caused simply by the quantity of emails received, but rather a smaller collection of harder demands that are received by email.

Other identified causes for techno-overload include when an individual is exposed to non-routine tasks, task interdependencies, task interruptions, and when time constraints are too tight (Paul and Nazareth 2010).
2.3.4.2 Techno-invasion

‘Techno-invasion’ describes a scenario in which technology causes a ‘blurring’ of the boundaries between work and personal contexts (Tarafdar et al. 2007). The author explains how technologies such as mobile and wireless computing devices have the capability to create a continuous connection to a network via emails and messages, which can cause stress both inside and outside of the workplace. This causes the individual to feel as though they are always reachable and “on-call”, which can be invasive and often extends to an employee’s vacation or holiday (Waltz 2012). The pervasiveness of ICT’s can provide real time support and increased productivity, but comes at the price of surrounding people with overwhelming rapid change that can interfere with their personal lives (Shu et al. 2008).

While techno-invasion can be a significant cause of technostress, Ayyagari et al. (2011) showed that the issue is not usually caused by an invasion of privacy as much as factors like work-home conflict, or an invasion of personal time that results in stress.

Barley et al. (2011) showed in a study of employees from three organisations that email was related to stress, regardless of how many hours were actually spent at work. This would suggest that work related emails can cause stress both inside and outside of the workplace. The study also showed that individuals are more likely to suffer from techno-invasion outside of the workplace if they have dependents or other primary responsibilities that prevent them from being able to attend to work-related emails, and allowing their inbox to fill up.

The 21st century has provided an environment that promotes the conditions for techno-invasion. The competitive nature of business and industry has forced organisations to reward employees who work long hours, and are connected to the organisation 24/7 (Ayyagari et al. 2011). It is therefore no surprise that technology is enabling organisations to demand more and more personal time from its employees.

Ahmad and Ahmin (2012) found in a study on 162 librarians that techno-invasion was the least significant of the five technostress components, although this may not be an accurate reflection of reality, as the IT systems the respondents were using were only accessible onsite (unlike many other organisations systems).
2.3.4.3 Techno-complexity

Techno-complexity is a scenario in which an individual experiences stress through failing to understand and manage the ever increasing complexity that technology demands (Tarafdar et al. 2007). The author argues that anxiety and fear amounting from the increasing complexity of technology is the cause for this type of technostress.

However, measuring techno-complexity is not as simple as taking measurements of technological complexity that result in predictable levels of stress - far from it. It is argued that the level of complexity that the individual experiences is as much to do with the individual’s expectations of complexity as the actual complexity itself. It has even been found in one study on 661 working professionals by Ayyagari et al. (2011) that there is no correlation between the actual level of complexity within the technology, and the measured levels of technostress in the individuals that are using that technology.

Investigating other causes for techno-complexity, Shu et al. (2011) found in a study of 305 respondents in 22 organisations that there was a link between techno-complexity and self-efficacy (even more than the other four technostress components). The findings suggest that an individual perceives the complexity of a technology to be greater (and therefore experience higher stress levels) if they have low self-confidence, which is an issue that could potentially be improved with adequate support and encouragement.

2.3.4.4 Techno-insecurity

The fear of losing one’s job or position within an organisation due to the inability to keep up with ever advancing technological change can cause stress. This is known as techno-insecurity (Tarafdar et al. 2007), and can often be caused by the constant upgrades and technological changes made within an organisation that cause an individual’s skills to become obsolete. Ayyagari et al. (2011) found that the pace of change was a reliable predictor for techno-insecurity, and employees often worried that changes in technology could potentially make them redundant.

In a study on 52 retail workers, Walz (2012) found that 39% of respondents had at least some level of techno-insecurity, with 10% experiencing severe levels. The study was limited to retail workers, although it did explore four different hierarchies within the organisation.
Just as with techno-complexity, the amount of techno-insecurity that an individual experiences could be greatly influenced by their own self-confidence. Shu et al. (2011) found a link between techno-insecurity and self-efficacy. Their study on 305 respondents from 22 organisations found that techno-insecurity and techno-complexity were the two technostress components most closely linked to self-efficacy. As with techno-complexity, the findings suggest that adequate training and support could be assist with mitigating of this type of technostress.

Ahmad and Amin (2012) found in a study on 162 Malaysian librarians that techno-insecurity was less significant than some of the other technostress components, although the respondents in the study were all 40 and younger, and the technology that they were using may have already been in place when they started work, meaning that the results may be an inaccurate predictor for this type of technostress.

2.3.4.5 Techno-uncertainty

The constant adoption and deployment of new technology within an organisation forces employees to adapt to technological changes, and puts pressure on individuals to learn and adapt to new technologies. This pressure can cause a type of technostress known as techno-uncertainty (Tarafdar et al. 2007); (Walz 2012).

Organisations are becoming ever more dependent on the use of advancing technologies in a competitive market (Barley et al. 2011), and although these changes provide competitive benefits, there is a darker side to the constant changes. Schellhammer et al. (2013) argue that technology advancements far outpace an organisation’s understanding of health and safety, as well as the quality of work life that is associated with them. ICT departments within American organisations are often half as productive as their foreign counterparts because of the constant deployment of new technologies (Tarafdar et al. 2007).

It is hardly surprising, given the high rate of change and development within the world of ICT’s (Riedl 2013), that the pressure of learning and adapting to new technologies causes a certain amount of stress, especially amongst those who are less keen to adopt new technologies.

Ahmad (2012) found moderate levels of technostress in Malaysian libraries, although both techno-uncertainty and techno-overload showed higher levels than the other three components.
The author argues that because of this, it is important for organisations to manage the ways of adapting to change in a sensitive manner.

### 2.3.4.6 Limitations of the Model

While the five components of technostress are widely used in current literature, the model has some limitations with regards to identifying causes of technostress. For example, the five components are geared towards identifying causes that assume the technology itself is working as intended. Studies such as Ayyagari et al. (2011) identify factors such as the reliability of technology and poor usability design that can have a substantial impact on technostress levels, while Weil et al. (1990) stress the importance of the ‘introducer’ of a new technology, and argue that their confidence levels can be passed on to a new user.

While the five components are concerned with different types of technostress causes, they take a high-level approach without closely identifying specific causes.

Another limitation is a lack of consistent studies. Research on the five technostress components has focused on different demographic groups, meaning that there is a lack of continuous data from any one particular study.

For these reasons, while the five components proposed by Tarafdar et al. (2007) can be used as a basis for technostress research, it is important to consider that unidentified factors may turn out to be significant technostress causes.

### 2.3.5 Technostress and the Advancement of Technology

A common theme found throughout existing technostress literature is on-going technological changes that force users to adapt to new technologies. Major technological changes can affect role stress, structural changes, anxiety levels, and technostress in the workplace (Tarafdar et al. 2007).

Techno-complexity, techno insecurity, and techno-uncertainty are specifically focused on stress that can result directly from adapting to new technologies, while the other two components (techno-overload and techno-invasion) are indirectly affected by advancing technologies that promote the conditions for these types of technostress. Shu et al. (2008) also showed that organisations that were more innovative and adopted new technologies had higher levels of technostress amongst employees.
Although many benefits are gained by adopting new technologies, such as improved communications, easy and rapid access to information, performance gains, and productivity gains (Riedl 2013), most new corporate systems fail to satisfy users (Self and Aquilina 2012), and IT project failures as shown in the CHAOS reports spanning the past two decades (Standish Group 1994, 1995, 1999, 2005, 2009) corroborate this.

It has been shown that different people react in different ways when new technologies are introduced into their lives. Rosen and Weil (1997, p17) describe the general population as being divided into three categories of technology adopters:

- 10-15% Early Adopters
- 50-60% Hesitant “Prove-Its”
- 30-40% Resisters

This shows that 85-90% have at least some level of concern with regards to adopting new technologies.

While some studies have identified specific technologies; smartphones (Lee et al. 2012); (Walz 2012), and email (Barley et al. 2011), most have taken a high level approach without identifying which specific technologies are causing stress and why.

The smartphone boom in recent years is a striking example of the widespread adoption of an advancing technology, and is one of the success stories of the twenty first century (Boulos et al. 2011), having penetrated into a wide range of demographics within all western industrialised nations.

2.3.5.1 An Advancing Technology: Smartphones

Since the original iPhone was released in 2007, smartphones have grown rapidly in the mobile phone market. There are now 6 billion worldwide mobile phone subscriptions and 1.2 billion mobile internet users (Riedl 2013), with the number of smartphone applications downloaded increasing from three hundred million in 2009 to five billion in 2010 (Boulos et al. 2011).

The current smartphone market consists of a vast array of devices, most of which have a relatively short shelf life before being updated or replaced by newer, more powerful models. Since its debut in 2007, Apple’s iPhone has seen eight different carnations (Apple-history 2013),
with similar comparisons seen across the rest of the smartphone market. Users are constantly encouraged to update their smartphones, switch providers, and spend more money on newer, better, and more powerful devices.

The current global smartphone market, which is dominated by devices that are powered by Google’s Android (79%) and Apple’s iOS (14%) (Gartner 2013) consists of smartphones with large screens, high memory, and powerful processors that are enabling individuals to use them as personal handheld computers (Boulos et al. 2011).

It is clear that mobile phones are now used as portable computing device and not just as a cell phone. According to The Huffington Post (2013), a study conducted by European telecom giant O2 concluded that the actual use of a smartphone as a telephone was ranked only fifth in frequency behind internet browsing, social networking, listening to music and gaming, and that other uses such as email and other data communications were also commonplace. The power and portability of smartphones mean they are now very frequently used for work-related purposes, with devices such as the Blackberry often being perceived as a business tool (Funtasz 2012).

2.3.5.2 Smartphones and Technostress

Some studies have shown that smartphone use can directly result in technostress; a study by Walz (2012) showed that 38% of respondents felt some kind of anxiety when they did not have their smartphone on them through fear of missing out on important communications, with 58% feeling pressure to instantly check incoming emails or messages.

Technostress has also been shown to affect the way that smartphones are used; a study on 268 respondents by Lee et al. (2012) showed that individuals with higher technostress levels were more likely to use their smartphones to make phone calls over choosing data communications such as email and text. This suggests that some individuals avoid using smartphones as personal computers due to technostress. They also showed that there was no link between technostress and previous smartphone experience, and that those with lower innovativeness were more prone to suffer from technostress through the use of a smartphone.

While these studies show interesting results, they are limited in the respect that they do not identify different ways in which smartphones cause technostress. There is a lack of current
research on the impacts of smartphones on technostress (Ayyagari et al. 2011) meaning more needs to be done in this area.

2.4 Conclusions

2.4.1 Key Issues
Technostress, which has been studied all over the globe in recent decades, remains a largely unresolved issue. Studies throughout the previous three decades have shown a gradual increase in technostress in virtually every demographic, with no sign of slowing.

Technostress, as with role stress, has been shown to reduce the productivity of an individual (Tarafdar et al. 2007); (Serva et al. 2011), meaning that directors and organisations need to consider its impact on an organisation, especially in light of the poor IT project success rates shown in the CHAOS reports (Standish Group 1994, 1995, 1999, 2005, 2009).

While no studies have comprehensively identified specific causes of technostress, existing literature does describe five different components, or types of causes. Originally developed by Tarafdar et al. (2007), these consist of techno-overload - where an individual is forced to respond to too many demands; techno-invasion - where technology blurs the boundary between work and personal time; techno complexity - where technology is complex and difficult to understand; techno-insecurity - where new technologies can threaten job security; and techno-uncertainty - where constant upgrades and new technologies prove difficult to keep up with.

In a modern world filled with ever changing technologies, individuals and organisations are under pressure to ‘keep up with the times’, and the adoption of new technology is constantly impacting on technostress levels either directly, or indirectly through creating the conditions for technostress.

Smartphones, which have come to dominate the market in industrialized nations, are now being used as portable personal computers (Boulos et al. 2011), and have been shown to cause technostress (Walz 2012); (Lee et al. 2012). While this has been identified, no studies have specifically shown the ways in which smartphones cause technostress and why, especially in relation to the five components developed by Tarafdar et al. (2007).
For this reason, smartphones and the way that they impact on the five components of technostress will be the focus area of this study.

2.4.2 Refined Research Question

What impact do smartphones have on techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty, and does this have an impact on general technostress levels?
3 Research Methodology

3.1 Introduction
The literature review identified five components of technostress, including techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty. Research on technostress has shown that all five components are affected either directly or indirectly by the pressures of adapting to new technology.

The research methodology is aimed at achieving three major objectives:

1. A measurement of general technostress levels. This will be achieved with the Rosen & Weil GATCS instrument. The results can be used to compare technostress against previous studies, as well as between demographic groups within this study (gender, age, and smartphone/non-smartphone users).

2. A measurement of the impact that smartphones have on techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty. This will be achieved with twenty Likert-scale questions that are based on the literature review.

3. Identification of any correlations between the smartphone findings, and the GATCS findings. This will allow for the identification of specific smartphone characteristics that are linked to higher general technostress levels.

3.2 Research Strategy
The research strategy will involve a survey that will generate quantitative data from a large group of people in a standardized and systematic way. This approach is suitable over other methods, as the data generated can be used to look for patterns and relationships that represent the larger population as a whole (Oates 2006, p. 35). This means that a conclusion can be drawn that will provide an insight into what impact smartphones could be having on technostress in the larger population.

3.3 Data Generation Methods
The data generation method for the survey will involve a self-administered questionnaire that will be sent via social media to a sample group of respondents.

A questionnaire has been chosen over other methods of conducting a survey, as it offers a highly efficient way of gathering data from a large number of people (Oates 2006, p. 220).
The survey will use three questionnaires that are explained in the following three sections.

3.3.1 Demographics Questionnaire
The demographics questionnaire will gather demographic data including age, gender, occupation status, and smartphone ownership. This will allow for the detection of different correlations for different groups, including smartphone operating systems and gender. These questions can be found in appendix 1.

3.3.2 General Technostress Measurement – GATCS Questionnaire
Measuring the general level of technostress in each individual will be achieved with the General Attitudes towards Computers Scale (GATCS Form C) developed by Rosen and Weil (1992). The tool was developed following 14 studies involving thousands students and professionals from 38 universities in 23 countries (Self and Aquilina 2012).

The original scale (GATCS Form A) consisted of 26 5-point Likert format questions that were based on common attitudes towards computers, and were judged and validated by a selection of professors and consumers, and used in 9 different studies which were used to refine the questionnaire itself (Rosen and Weil 1992). The scale was used in 8 studies, and subsequently refined, keeping 13 of the questions and adding 7 new ones, resulting in the 20 question GATCS Form C.

In order to avoid biased responses, the GATCS questionnaire uses a mixture of positively and negatively phrased question. Upon analysis, the negatively phrased questions are inverted, meaning that a low GATCS score will indicate high technostress.

The GATCS questionnaire has been used by various research groups including (McIlroy et al., 2001), (North and Noyes, 2002), and (Self and Aquilina 2012).

The GATCS Form C questionnaire can be found in appendix 1.

3.3.2.1 GATCS Questionnaire Scoring
Based on various studies, including the data from the Model Computerphobia Reduction Program, plus the distributional characteristics of each measure, Rosen and Weil (1992) proposed a three-tiered measurement, including moderate/high, low, and no technostress. Each respondent
will be divided into one of these three groups. Table 3.1 illustrates the scoring for the GATCS questionnaire developed by Rosen and Weil (1992).

<table>
<thead>
<tr>
<th>GATCS (Form C)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Technostress</td>
<td>64-100</td>
</tr>
<tr>
<td>Low Technostress</td>
<td>56-63</td>
</tr>
<tr>
<td>Moderate/High Technostress</td>
<td>20-55</td>
</tr>
</tbody>
</table>

**Table 3.1: GATCS Scoring**

### 3.3.3 Smartphone Technostress Measurement - Smartphone Questionnaire

The smartphone questionnaire will measure the impact of smartphones on each of the five technostress components. This consists of 20 five-point Likert scale questions. Each of the five technostress components developed by Tarafdar et al. (2007) is represented by four questions, making up twenty in total.

Some questions are negatively phrased and others positively phrased, helping to avoid biased responses (Rosen and Weil 1992). In order to deal with the possibility of respondents with multiple devices, the questionnaire prompts each respondent to base all relevant responses on their most frequently used smartphone. Individuals who do not own a smartphone will not be used for the smartphone sections of the analysis.

Table 3.2 contains a detailed description of each question.
Table 3.2: Smartphone Questions

The smartphone questionnaire can be found in appendix 1.

3.3.3.1 Smartphone Questionnaire Scoring

Upon analysing the data, all positively phrased smartphone responses will be inverted. The 20 questions will then be split into the five separate technostress groups (overload, invasion, complexity, insecurity, and uncertainty), resulting in four questions for each group. The four
questions within each group will then be added together which will produce a result between 4 and 20. 4 will then be deducted from the final score, leaving 0 as a reference point that will represent no technostress. A result of 16 will represent the highest level of that type of technostress.

3.4 Data Analysis

The two Likert-scale questionnaires used in the survey will generate ordinal quantitative data. Analysing quantitative data is an appropriate approach for the survey as it can be used to identify correlations between two or more entities (Oates 2006 p.38). In this instance, the two entities being compared are technostress levels (GATCS), and the five technostress components in the context of smartphone use (smartphones questionnaire).

3.4.1 Linking the Two Measurements

The smartphone responses will be compared against the GATCS responses in order to identify any correlation between the two. This will involve comparing each technostress component, as well as the overall smartphone score.

Analysing the quantitative data in this manner will enable the identification of correlations between technostress levels and smartphone causes.

3.5 Sampling

3.5.1 Sampling Frame
Details of smartphone ownership will be obtained in the demographics questionnaire. As the study is designed to investigate the impact of smartphones, respondents who do not own one will not be used for any data analysis concerned with smartphones. All respondents will be used for the analysis only concerned with general technostress (GATCS instrument).

3.5.2 Sampling Technique
Sampling will involve sending out emails to a large group of people via social media. This will include a covering letter, Participant Briefing and Consent Letter, Participant Debriefing and Withdrawal Letter, and a link to the online survey.
3.6 Ethics
The survey will abide by The University of Derby ethical guidelines. All respondents will remain anonymous with no personal connections to any data. Each respondent will receive a Participant Briefing and Consent message, and Participant Debriefing and Withdrawal message which will enable them to request withdrawal from the study.

3.7 Limitations of the Current Study

3.7.1 Discrete Categories
Although the GATCS instrument has been used in various studies (McIlroy et al., 2001), (North and Noyes, 2002), (Self and Aquilina 2012), there are certain limitations with placing respondents into three discreet categories (Moderate/high, Low, No Technostress). The approach does not take into consideration differences within each category. While this can help provide simplicity, it results in a loss of detail (De Vaus 2002, p. 34). A more representative method could be adopted that takes into account a continuous scale of results rather than placing them into discrete categories.

3.7.2 The Age of the Tools
While the Rosen and Weil measurement tools have been validated and widely used for measuring technostress, GATCS Form C was developed in the 1990’s, and could be updated in order to provide more of an accurate reflection of technostress in the 2010’s.

3.7.3 Sampling technique
The sampling method used involves gathering responses via social media, which is categorised as convenience sampling. Convenience sampling is a non-probabilistic sampling method that is less representative of larger population than well-designed probabilistic sampling methods (Oates 2006 p.96).

3.7.4 Biased Sampling
As the study relies on respondent voluntarily completing an electronic survey via the internet, it is possible that individuals who suffer from high levels of technostress would be more likely to avoid completing the questionnaires than those with lower levels, potentially biasing the results in favour of lower technostress. This is an area that could be addressed in future research on technostress.
3.7.5 Likert Scale Limitations
The Likert-scale questionnaires are limited in the respect that they only produce ordinal quantitative data. While this can be insightful, it is limited in the respect that it does not provide an accurate measurement of what lies between each of the steps on the 5-point Likert scale, limiting the arithmetical analysis of the data (Oates 2006 p.247). One respondent’s “strongly agree” is subjective, and could differ somewhat from the next respondent’s idea of what “strongly agree” means.

3.7.6 Single data generation method
The survey uses a single data generation method. While this may be relatively simple and resource effective, using multiple data generation methods can provide alternative insights (Oates 2006 p. 37).

3.8 Conclusions
The method for this study is designed to gather quantitative data that will achieve three objectives. The first objective is to measure the current levels of technostress (GATCS) amongst the response group. This can be used to compare technostress against previous studies, as well as between demographic groups within the study (age, gender etc.).

The second objective is to measure the effects that smartphones have on techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty.

The third objective is to identify any correlation between smartphone technostress and general technostress.
4 Findings and Analysis

4.1 Introduction
The research methodology was designed to achieve three major objectives; to measure general levels of technostress, to measure the five technostress components in the context of smartphones, and to identify correlations between the two.

In order to answer the refined research question, various graphs and charts have been used that each present a unique perspective on the data with regards to general technostress, smartphone technostress, demographic divides, and correlations within the data.

4.2 Analysis

4.2.1 Response Rate
Survey respondents were obtained via the social media networking website www.facebook.com. A request was sent to 1,713 people and a total of 198 responses were received. Of these, 55 were incomplete and therefore cannot be used for the study. This leaves a total of 143 completed responses resulting in an 8.35% response rate.

Of the 143 respondents, 9 did not own a smartphone and therefore will not be used for the smartphone related sections of the analysis.
4.2.2 Demographics

4.2.2.1 Age Groups

The survey respondents ranged from the ‘under 25’ age group, through to the ’70+’ age group. Figure 4.1 displays the quantity of respondents within each age group. The majority of respondents fell into the 25-39 age group, although there were still a substantial number outside of this.

Figure 4.1: Demographics: Age Groups
### 4.2.2.2 Gender

![Gender Pie Chart]

**Figure 4.2: Demographics: Gender**

Figure 4.2 displays the male/female ratio within the response group. There were a higher number of female respondents (90), although there were still a substantial number of male respondents (53).
4.2.2.3 Smartphone Types

Figure 4.3 displays the quantities of different smartphone types within the response group. The vast majority of respondents had either an Apple iOS or Android smartphone, although there were also Windows and Blackberry owners as well as three that owned ‘Other’ smartphone types, and nine without smartphones.
4.2.3 GATCS Technostress Findings

The GATCS instrument has been used to measure general (not smartphone specific) technostress within the response group. Technostress levels for the whole response group have been measured, as well as a comparison between gender groups, age groups, and smartphone/non-smartphone groups.

4.2.3.1 GATCS Score Overall

Figure 4.4 displays overall technostress within the response group, as indicated by the GATCS instrument. The data shows a relatively low number (35.67%) of respondents’ suffering from some level of technostress, and conversely 64.34% showing ‘No Technostress’. Of the respondents showing technostress, 32.17% showed low levels of technostress, and only 3.5% showed High/Moderate levels.
4.2.3.2 GATCS Score by Gender

Figure 4.5 displays overall technostress grouped by gender, as indicated by the GATCS instrument. The data does not indicate any substantial difference between males and females. 64% of both groups showed no technostress, and only a very small minority of both groups showed high/moderate technostress.
Figure 4.6 displays overall technostress grouped by age groups, as indicated by the GATCS instrument. The ‘40-54’ age group had the highest percentage (62.07%) of respondents showing some level of technostress. The youngest group (Under 25) had the lowest percentage of respondents with technostress (15.38%), although the older age groups (55-69 & 70+) also had a lower percentage than the 40-54 age group.
4.2.3.4 GATCS Score by Smartphone/Non-Smartphone Owners

![Chart: GATCS Score by Smartphone/Non-Smartphone Owners](image)

**Figure 4.7: GATCS Score by Smartphone/Non-Smartphone Owners**

Figure 4.7 displays overall technostress grouped by Smartphone/non-smartphone owners, as indicated by the GATCS instrument. The non-smartphone owners showed a much higher percentage of respondents with technostress (77.77%) than the smartphone owners (32.84%). This shows that respondents who suffer from higher levels of technostress are less likely to own a smartphone.

While this is a staggering result, it is worth noting that the non-smartphone group is based on nine respondents only, and therefore limited in how representative it is.
4.2.4 Smartphone Technostress

The smartphone questionnaire has been used to measure smartphone specific technostress within the response group. This focuses specifically on the five technostress components (Tarafdar et al. 2007) in relation to smartphones. The 9 respondents without a smartphone are excluded from this section of the analysis, leaving a total of 134 respondents. Each bar chart displays a score of 0-16 which is the sum of the four Likert-scale questions for each component, 0 being equal to zero smartphone technostress and 16 being equal to maximum smartphone technostress.

4.2.4.1 Smartphone Technostress Overall

![Bar Chart]

**Figure 4.8: Smartphone Technostress Overall**

Figure 4.8 displays the average score for each of the five technostress components in relation to smartphones. The chart uses an average score that is based on the whole response group.
The most severe type of smartphone technostress is techno-overload, with an average score of 8.73. This suggests that pressures to multitask, constant interruptions, and increased workload are the most frequent smartphone stressors within the response group.

The second and third most severe components were techno-complexity with a score of 7.79 and techno-invasion with a score of 7.04. This suggests that learning how to use a new smartphone, difficulties with understanding how a smartphone works, and an invasion of personal time are also common smartphone technostress causes.

The final two components (techno-insecurity with 5.84 and techno-uncertainty with 6.6) are less severe than the other three; although still show a substantial presence on the scale of 0-16. This suggests that smartphone related job-insecurity, pressure to use a smartphone for work, struggling to deal with updates and changes, and upgrading to a new smartphone were less common factors, although they were still present.

The average of all five components is 7.2, suggesting that smartphones are causing a substantial amount of technostress overall.
### 4.2.4.2 Smartphone Technostress by Smartphone Type

![Smartphone Technostress by Smartphone Type](image)

**Figure 4.9: Smartphone Technostress by Smartphone Type**

Figure 4.9 displays the average score for each of the five technostress components, grouped by smartphone type.

The highest total average was shown in Blackberry users, who also had the highest techno-insecurity and techno-overload. This is not a surprise given that techno-overload and techno-insecurity are both largely concerned with work-related stress (Tarafdar et al. 2007), and Blackberry phones are often associated with business use (Funtasz 2012).

Windows smartphone owners showed the least overall amount of smartphone technostress, followed shortly behind by Apple iOS owners. Techno-complexity and techno-uncertainty were highest in the ‘Other’ smartphone group, although this group only consisted of three respondents so is unlikely to be representative.

It is worth noting that the Blackberry and Windows groups only consisted of seven respondents each, and therefore may not be representative of this population as a whole.
4.2.4.3 Smartphone Technostress by Gender

Figure 4.10 displays the average score for each of the five smartphone technostress components, grouped by gender.

While females showed a slightly higher average score than males (7.42 compared to 6.84), the overall difference was minimal. The component with the greatest difference was techno-complexity, with the female score of 9.07 much higher than the male score of 5.64. This could suggest that females find smartphones more confusing, difficult to learn, and do not use them to their full potential as much as males.
4.2.4.4 Smartphone Technostress by Age Group

Figure 4.11 displays the average score for each of the five technostress components in relation to smartphones, grouped by age groups.

As with the general technostress results, the 40-54 age group showed the highest average amount of smartphone technostress, although only by a small margin. Techno-complexity and techno-uncertainty showed a general trend of increasing with age. This suggests that older age groups are more likely to find smartphones confusing, difficult to learn, do not use them to their full potential, and are more sensitive to a high number of smartphone updates/changes, as well as upgrading to a new smartphone.

Techno-overload and techno-invasion show the opposite of this, with the younger age groups showing increasing levels than older groups, suggesting that younger smartphone owners suffer more from fast paced multitasking, interruptions, and invasion of personal time.
4.2.5 GATCS and Smartphone Technostress Correlations

In order to answer the refined research question, a comparison has been made between the GATCS general technostress measurement and the smartphone technostress measurement. This helps to identify an overall correlation, as well as correlations between GATCS and each individual type of smartphone technostress.

4.2.5.1 GATCS and Smartphone Technostress Correlation

Figure 4.12: GATCS and Smartphone Technostress Correlation

Figure 4.12 displays a correlation between the GATCS instrument and overall smartphone technostress. The Y axis displays a number that represents the total sum of all five smartphone technostress types (a higher score equals higher smartphones technostress). The X axis displays the GATCS score (a lower number equals higher general technostress), meaning that a negative correlation coefficient will reflect a positive correlation between smartphone technostress and GATCS technostress. Each point on the scatter plot represents one respondent.
The graph shows a negative Pearson correlation coefficient of \( r = -0.37035 \) between the smartphone score and the GATCS score, which is indicative of a ‘medium’ strength negative correlation (Laerd Statistics 2013). The negative correlation shown indicates a positive correlation of \( r = 0.37035 \) between general technostress and smartphone technostress.

Although the correlation is evident, it does not fall into the category of ‘large’ in strength (Laerd Statistics 2013). This suggests that although respondents who suffer from high general technostress are more likely to also suffer from smartphone technostress, the relationship between these two factors is not a strong one.
4.2.5.2 GATCS and Smartphone Technostress Correlation by Technostress Component

![Graphs showing correlation between GATCS and technostress](image)

*Figure 4.13: GATCS and Smartphone Technostress Correlation by Technostress Component*
Figure 4.13 displays a correlation between the GATCS instrument and each individual smartphone technostress component. The Y axis displays a number that represents each smartphone technostress type (a higher score equals higher smartphones technostress for that component). The X axis displays the GATCS score (a lower number equals higher general technostress), meaning that a negative correlation coefficient will show a positive correlation between smartphone technostress and GATCS technostress. Each point on the scatter plots represents one respondent.

The two components with the strongest correlation to the GATCS score were techno-uncertainty with a coefficient of \([r = -0.25185]\), and techno-complexity with a coefficient of \([r = -0.22299]\). Respondents who had smartphone issues such as struggling to deal with updates and changes, upgrading to a new smartphone, learning how to use a new phone, and understanding how their smartphone works were more likely to suffer from general technostress than respondents who scored high on other components.

The two components with the weakest correlation to the GATCS score were techno-insecurity with a coefficient of \([r = -0.17570]\), and techno-overload with a coefficient of \([r = -0.13769]\). Respondents who suffered from job insecurity, pressure to use a smartphone for work, pressure to multitask, and increased workload through their smartphone were less likely to have higher general technostress than respondents who scored high on other components.

While some components show a higher correlation than others, all five components fall into the ‘small’ strength correlation group (Laerd Statistics 2013), meaning all are slightly correlated with general technostress, but with no strong correlation.
4.2.5.3 GATCS and Smartphone Technostress Correlation (smartphone averages)

![Bar chart showing GATCS and Smartphone Technostress Correlation (smartphone averages)](image)

Figure 4.14: GATCS and Smartphone Technostress Correlation (smartphone averages)

Figure 4.14 displays an alternative perspective on the correlation between smartphone technostress and general technostress. The Y axis represents the average score for each smartphone component. The ‘High/Moderate’ GATCS group appears highest on the smartphone scale for each component apart from techno-uncertainty, and techno-complexity. These may only show the ‘Low’ technostress group as having higher levels due to a loss of accuracy when grouping the GATCS score into the three discreet technostress groups.

The ‘Total Average’ bars indicate the overall relationship between smartphone technostress and the three GATCS groups.
4.3 Key Findings

The key findings from the research are as follows:

I. A substantial percentage (35.67%) of respondents suffer from general technostress, although the findings indicate that the majority of these (32.17%) suffer from ‘Low’ technostress, and only 3.5% from ‘Moderate/High’ levels.

II. Males and females show roughly an equal amount of general technostress.

III. The ‘40-54’ age group showed the highest levels of general technostress.

IV. Non-smartphone owners showed a substantially higher percentage (77.77%) with general technostress than smartphone owners (32.84%), although the non-smartphone group only consisted of nine respondents, and therefore may not be representative.

V. Smartphones cause a substantial amount of technostress, with techno-overload being the most prevalent cause and techno-insecurity the least prevalent cause.

VI. Blackberry owners suffered from the highest level of smartphone technostress, and Windows owners suffered the least smartphone technostress, although the sizes of these response groups were limited and may not be representative.

VII. There was no substantial difference in smartphone technostress between males/females, although females showed higher levels of smartphone techno-complexity.

VIII. The younger age groups showed the highest levels of smartphone techno-overload and techno-invasion, and the older age groups showed the highest levels of smartphone techno-complexity and techno-uncertainty.

IX. There is a correlation coefficient of \([r = 0.37035]\) between general technostress and smartphone technostress. Respondents with higher general technostress were more likely to show higher smartphone technostress, although the correlation is not strong.

X. Of the five technostress components, smartphone techno-uncertainty and techno-complexity showed the strongest correlation with general technostress. Techno-insecurity and techno-overload showed the weakest correlation, although all five components were correlated to some degree.

4.4 Conclusions

The purpose of this chapter was to analyse and present the survey data in a way that enables questions about the research topic to be answered.
The research suggests that although technostress is not as high as recent studies have shown, it is still prevalent enough to be a serious issue. It is also clear that smartphones are causing their own forms of technostress, with different demographic groups being more sensitive to certain stressors than others.

The findings and analysis has helped to answer questions about smartphones and their effects on technostress. The information that has been produced will be used in the following chapter to gain an understanding of what questions have been answered, and what questions still need to be asked.
5 Discussion

5.1 Introduction

This study has investigated technostress in 143 respondents from mixed demographics, and examined three major elements of technostress:

- General technostress
- Smartphone technostress
- The relationship between general technostress and smartphone technostress

This chapter will investigate the findings from the study, what information has been gained, and what implications they have for the wider research area.

5.2 General Technostress

5.2.1 Current Levels of Technostress

The 1992 study conducted by Rosen and Weil showed that 35% of respondents suffered from technostress. The collection of studies investigated in the literature review have shown an average increase over time, with a correlation coefficient of \( r = 0.60104 \) between technostress percentage and time (See chapter 2 - Figure 2.2). Although the studies conducted in 2013 showed the highest average levels of technostress, this 2014 study has shown a lower percentage than the majority of recent findings, with only 35% of respondents suffering from general technostress. While this could be interpreted as a positive finding, over a third still showed some technostress. This exactly matches the original Rosen and Weil (1992) study, meaning that the issue has not improved since then. With this study added, the trend within the sample studies still shows a correlation coefficient of \( r = 0.49950 \) (see figure 5.1) which is only a fraction off being a “large” correlation (where \( r = 0.5 \)) (Laerd Statistics 2013). It is also worth noting that only a minority of respondents from this study (3.5%) show “Moderate/High” levels of technostress, showing a high prevalence in the population rather than a high severity in individuals.
The results from this study have produced three vital pieces of information about technostress levels:

- Firstly, over a third (35.67%) of respondents are currently showing some level of technostress, which is a substantial amount, especially since it has been shown to reduce the productivity of an individual in the workplace (Tarafdar et al. 2007).
- Secondly, while this study shows lower levels than other recent studies, there is still a positive correlation coefficient of \( r = 0.49950 \) within the sampled studies between time and technostress levels.
- Thirdly, only a small percentage (3.5%) show “moderate/high” levels, meaning that the emphasis is on technostress being widespread rather than being severe in any particular individual.

### 5.2.2 Technostress by Demographic Groups

Previous technostress studies have shown technostress to be prevalent in virtually every demographic area. Studies including (Rosen and Maguire 1990); (Rosen and Weil 1992); (Rosen...
and Weil 1995); (Clute 1998); (Tarafdar et al. 2007); (Weng et al. 2008); (Self and Aquilina 2012); and (Ahmad and Amin 2012) have shown a high frequency of technostress in varied demographic groups ranging from different hierarchies within a single organisation to multi-national and multi-organisational groups. The findings from this study also show that technostress is present within all of the investigated demographic groups.

Tarafdar et al. (2007) showed that men had slightly higher average levels of technostress than women, and that older and more experienced users showed lower levels than younger and less experienced users. This study does not reflect this, with the 40-54 age group showing more technostress than any other group, and the older groups showing more on average than the younger groups. This study also suggests that there is no substantial difference between males/females, which also does not reflect the findings my Tarafdar et al. (2007).

Lee et al. (2012) showed that individuals with higher overall technostress were less likely to use their smartphones as personal computers. This study has shown that non-smartphone owners have substantially higher levels of technostress than smartphone owners, suggesting that technostress is causing people to avoid technology. This has serious implications given that organisations are becoming ever more dependent on technology (Barley et al. 2011).

5.3 Smartphone Technostress

The literature review identified a shortage of studies investigating the effects of smartphones on technostress. However, some research groups have touched on the subject. Lee et al. (2012) showed that respondents with higher technostress were less likely to use their smartphones as personal computers. Walz (2012) showed that 38% of respondents felt some kind of anxiety when they did not have their smartphone on them through fear of missing out on important communications. 58% of these respondents also reported feeling pressure to instantly check incoming emails or messages, suggesting high levels of smartphone techno-invasion.

This study has shown that smartphones often cause their own kind of technostress, with an average total score of 7.2 on a scale of 0-16 based on all five components.

Out of the five components, techno-overload, techno-complexity, and techno-invasion were the most prevalent stressors, suggesting that pressures to multitask, constant interruptions, increased
workload, learning how to use a new smartphone, difficulties with understanding how a smartphone works, and an invasion of personal time are the most serious smartphone stressors.

Of the different demographic groups, Blackberry users showed the highest amount of smartphone technostress, and Windows users showed the lowest amount. This is an area that needs further research, with larger response groups than this study.

As with the general technostress findings, there was no significant difference between males/females when it came to smartphone technostress. The only substantial difference was with techno-complexity, which was higher in females. More research is needed that investigates why females may find smartphones more confusing, difficult to learn, and do not use them to their full potential.

Although there was not a big difference in overall smartphone technostress between age groups, there was a big difference between age groups with regards to certain technostress components. Techno-complexity and techno-uncertainty were substantially higher in the older age groups, and techno-overload and techno-invasion were substantially higher in the younger age groups. This suggests that older respondents are more affected by stressors arising from direct use of smartphones (e.g. complexity of the technology, sensitivity to updates and changes), while the younger respondents are more affected by indirect stressors that smartphones provide (e.g. interruptions, multitasking, and invasion of personal time). More research is needed that will answer why this is the case, and what can be done to improve the situation for different age groups.

5.4 Is Smartphone Technostress Linked to General Technostress?

One of the aims of the research was to investigate what impact smartphones have on general technostress. The research has identified a correlation coefficient of $r = 0.37035$ between these two factors, which shows a medium strength correlation (Laerd Statistics 2013).

The data shows that respondents who have higher smartphone technostress are a little more likely to show higher general technostress. Although this association is clear, it is limited in that it shows correlation but not causation. The correlation suggests three possible scenarios:
1. Stress caused by smartphones is also causing people to have higher general technostress. In this scenario, smartphones are identified as a cause for increased levels of general technostress.

2. High levels of general technostress are also causing people to show high levels of smartphone technostress. In this scenario general technostress is identified as a cause for increased levels of smartphone technostress.

3. An unidentified factor is causing some respondents to suffer from high levels of both general and smartphone technostress.

Further research is needed to investigate these potential scenarios in order to identify what is causing the association between general and smartphone technostress.

### 5.5 Conclusions

This study has identified that technostress is still a widespread issue, and that smartphones are contributing to the problem. There is a mixture of different types of smartphone technostress, with some demographic groups (e.g. age groups) being more sensitive to certain kinds than others, some of which do not corroborate findings from previous research.

There is an association between general technostress and smartphone technostress, and further research is needed to identify what is causing this association.
6 Conclusions and Recommendations

6.1 Conclusions
The aim of this study was to identify specific technostress causes, and recommend steps to be taken towards resolving them.

This study has generated new insights that have focused on general technostress, smartphone-specific technostress, how different demographic groups are affected by both, and what the relationship between the two is. These insights can be used by both individuals and organisations when considering the impacts of adopting new technologies, as well as for future research.

This study has shown 35.67% of respondents suffering from technostress, as indicated by the GATCS instrument. Although this is lower than many recent studies, it is still a substantial percentage that matches the findings from the Rosen & Weil (1992) study, meaning the situation has not improved since then. While it is clear that technostress is still a common issue, only 3.5% of respondents show “Moderate/High” levels, showing a high prevalence in the population rather than a high severity in individuals.

Contrary to previous research (Tarafdar et al. 2007), males and females did not show any substantial difference, and older groups showed higher technostress on average than younger groups. More research is needed that investigates the differences between age groups, and gender, to address these conflicting results.

This study has also shown that smartphones are frequently causing their own types of technostress, with younger age groups being more sensitive to indirect smartphone stressors (e.g. smartphone interruptions, multitasking, and invasion of personal time), and older age groups more sensitive to direct smartphone stressors (e.g. complexity of the technology itself, sensitivity to updates and changes etc.).

While there is no strong association between smartphone technostress and general technostress, there is a medium strength correlation that could be indicative of one causing the other, although this is a question that needs to be addressed in future research.
6.2 Recommendations

6.2.1 Recommendations for Organisations

This study has identified multiple ways in which smartphones are causing stress, and given the negative effects on the productivity and wellbeing of individuals, organisations need to take the issue very seriously when adopting new technologies such as smartphones.

The most prevalent smartphone stressors are techno-overload and techno-complexity. For this reason, it is important to consider the negative effects of expecting employees to use their smartphones for multiple work-related purposes. It is also important to ensure that support and training is provided to employees who are expected to use a smartphone for work, but struggle with learning how to use it.

Smartphone techno-invasion, which is the third most common stressor, is effectively making many feel permanently connected to their workplace. While this might be desirable in some circumstances, it is important to consider the effects of contacting employees outside of work hours (e.g. emails), as many individuals are showing stress through an invasion of personal time.

Smartphone techno-uncertainty and techno-insecurity are less prevalent than the other components, although still common enough to have a considerable impact. Many individuals suffer from stress through being forced to upgrade and adapt to a new smartphone, as well as feeling their job is threatened if they do not manage this. It is worth considering the potential damage that these pressures can cause, and avoid placing unnecessary pressure on employees whenever possible, as well as providing alternative options if they are available.

6.2.2 Further Research

Although certain questions have been answered, this study has also generated new questions with regards to technostress research.

With regards to general technostress, further research is needed that produces more representative findings on the effects of technostress on different demographic groups. This study is contradictory to existing research when it comes to technostress and age/gender divides.

With regards to smartphones, further research is needed that addresses the association between general technostress and smartphone technostress. It is important to investigate whether one is
influencing the other, or if an unidentified variable is influencing both. Answering this question could help to identify specific factors that may lead to solutions to these issues. There is also a need for research that focuses on why younger age groups are more sensitive to smartphone techno-overload and techno-invasion, and why older age groups are more sensitive to smartphone techno-complexity and techno-uncertainty. Research in this area could lead to solutions that deal with the way smartphones cause stress within different age groups.

Other research could focus on why Blackberry users show higher smartphone technostress, why females show higher smartphone techno-complexity, and other stressors not covered in this study such as poor usability design or poor reliability of smartphones.
7 Personal Reflection

Overall I am pleased with the way the project turned out. I set out with the intention of learning something new and answering some unanswered questions about an important topic, and I feel as though I have achieved this. Applying the techniques I have learned throughout my time at university to a final year dissertation project has been both challenging and rewarding.

One of the key challenges was time management. Due to the size of the research area, I spent the entire first term researching the topic and writing the literature review, which left too little time for other important aspects such as researching survey and statistical analysis techniques, which I feel may have been rushed in places.

Another time management challenge was prioritising between this project and my other university modules, and I feel as though this project has chipped away at the amount of time that I spent on them.

Although I am happy with the project as a whole, I do feel as though it is limited in some aspects. Firstly, the study focused on ways in which smartphones can cause technostress based on the five components developed by Tarafdar et al. (2007). While this provided a compelling framework to base the study on, it does not cover all aspects of smartphone related stress, for example usability and reliability issues. Secondly, the research was limited in that it used convenience sampling, which is not as representative as many other sampling techniques, as it is a non-probability sampling method.

7.1 What I Would do Differently Next Time

- Interact more with other students studying the same subject. I had minimal contact with the students who were also working on technostress dissertations, and we could have learned more from each other.
- Adopt a probability sampling technique, and avoid convenience sampling.
- Aim for a larger response group.
- Develop better time management, especially with regards to prioritising between tasks within this project, as well as between my university modules.
- Spend more time learning about statistical analysis and sampling techniques.
8 Bibliography


Rosen, L. D., & Weil, M. (1992) Measuring Technophobia, A Manual for the Administration and Scoring of the Computer Anxiety Rating Scale (Form C), the Computer Thoughts Survey (Form C) and the General Attitudes Toward Computers Scale (Form C), California State University.


Rosen, L., & Weil, M. (1997) TechnoStress: Coping with Technology @work @home @play, John Wiley and Sons.


Appendices

Appendix 1: Questionnaires

**GENERAL ATTITUDES TOWARD COMPUTERS SCALE**  
(Form C)

The following statements address general attitudes toward computers. Place a check (✓) under the column that describes your level of agreement (Strongly Agree, Agree, Neutral, Disagree or Strongly Disagree) to each statement.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Computers can save people a lot of work.</td>
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<td>2. It takes a good math background to learn to use a computer.</td>
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<td>3. You need to know how to use a computer to get a good job.</td>
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<td>4. Computers can help solve society’s problems.</td>
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<td>5. Computers are taking over.</td>
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<td>6. Computers can increase control over your own life.</td>
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<td>7. Computers increase the amount of time we have for other activities.</td>
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<td>8. Men are better with computers than women.</td>
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<td>10. In the future there will still be jobs that don’t require computer skills.</td>
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<td>11. Computers are good teaching tools.</td>
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<td>12. Use of computers can cause physical health problems.</td>
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<td>13. Computers prepare students for the future.</td>
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<td>14. Computers are taking jobs away from people.</td>
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<td>15. Some ethnic groups are better with computers than others.</td>
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<td>16. There is an overemphasis on computer education in this society.</td>
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<td>17. Computers can ruin interpersonal relationships.</td>
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<td>18. In five years everyone will need to know how to operate a computer.</td>
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<td>20. Computers will never be smarter than people.</td>
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</tbody>
</table>

©1985; 1988 Deborah C. Sears, Ph.D., Larry D. Rosen, Ph.D. and Michelle M. Weil, Ph.D.

Smartphones Questionnaire
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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</thead>
<tbody>
<tr>
<td>My smartphone is constantly alerting me</td>
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<td>My smartphone distracts me from other important tasks</td>
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<tr>
<td>I have to use my smartphone for multiple work related purposes</td>
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<td>My smartphone reduces my overall workload</td>
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<td>I am available 24/7 via my smartphone</td>
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<td>I have to read work related emails on my smartphone outside of work hours</td>
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<td>My smartphone sometimes wakes me in the night</td>
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<td>I never get any peace from people contacting me on my smartphone</td>
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<td>I understand how to use everything on my smartphone</td>
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<td>My smartphone can be confusing</td>
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<td>I use my smartphone to its full potential</td>
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<tr>
<td>I should spend more time learning how to use my smartphone</td>
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<td>I would be less productive than my colleagues if I didn’t use a smartphone</td>
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<td>My job is threatened if I don’t keep updated with a modern smartphone</td>
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<td>I can manage my job without a smartphone</td>
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<td>My colleagues are better at using a smartphone than me</td>
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<td>I find it hard to adjust to a new smartphone</td>
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<td>I enjoy updating to a new operating system</td>
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<tr>
<td>I get too many updates and changes</td>
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<tr>
<td>My smartphone was difficult to learn how to use</td>
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</table>
Demographics Questionnaire

Age

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
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</table>

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Full-Time</th>
<th>Part-Time</th>
<th>Unemployed</th>
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<table>
<thead>
<tr>
<th>Operating System</th>
<th>iOS</th>
<th>Android</th>
<th>Windows</th>
<th>Blackberry</th>
<th>Other</th>
<th>N/A.. I do not own a smartphone</th>
</tr>
</thead>
</table>

My smartphone operating system is….
(If you have more than one, please select your primary smartphone and base all relevant answers on this one)