Investigating the information technology productivity paradox in the heavy metal engineering industry

by

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ABSTRACT

Studies have shown that computers have a positive impact on productivity, but the reality remains that the productivity figures have not yet changed. This aforementioned irregularity is referred to as the "productivity paradox".

The question of how productivity is measured is complicated when, for example, a company connects all their computers onto a network or installs an information system to keep record of customer information or even supplier information, for there are no input and output ratios that can be measured. In these cases, productivity is not so evident, and some might argue that it does not exist. Companies always look for the competitive advantage and it is therefore important to show whether investing in information technology does in effect give them a greater return on investment.

The question of why it is important for information technology to increase productivity is answered by looking at what all companies seek, which is sustainable growth. This can be measured by the accounting return on investment, economic value added (EVA), and growth in sales or assets. The goal of this study is to determine the impact the information technology productivity paradox has on the heavy metal engineering industries, whether it be good or bad.

Information technology has expanded to such an extent that more people are starting to rely on information technology in order to do their work and communicate with one another. This is what makes this study so important, especially from an organisation's perspective, as the organisation is spending more money on expanding its information systems.

One of the aspects to be covered in this study is the evolution pertaining to the history of information technology and how it has improved over the years. It also looks at the laws of information technology like Moore's Law which explains that the transistors on a chip would roughly double every two years, and Gilder's Law that explains in total communication a system triples every twelve months.

Within this study the knowledge expansion and how human knowledge had to expand in order to keep up with the ever escalating information technology is covered. When looking at the future and the rate at which knowledge increases people tend to assume that the current rate of progress will continue in future periods. This, however, when looking at the rate at which technology progresses, is evident that the progress is not constant.

The research topic for this study is the information technology productivity paradox. This term suggests that there is no correlation between a company's investment in information systems and its business performance measured in terms of productivity. This phenomenon was shown to exist within this study.

Open source systems are covered, which is a method of developing software that harnesses the power of distributed peer review and transparency of process. Open source systems have the following advantages like easing of licensing restrictions; cross-platform simplicity; possibility to run modules on any operating system; low cost due to no licensing fees; modification of system is possible; and disadvantages like lack of necessary expertise to do modifications; less user-friendly, support is not always available; security might be a problem.

In this way open source systems will affect productivity in information technology due to the less user-friendly interface. Some of these open source systems might take longer to do the task than it would on the commercial software. Implementation of the open source system might take longer than that of a commercial system as there might be a lack of support for the system.

Another topic covered within this study is the development of human capital, which is a necessity for employees in an organisation in order to enhance both knowledge and skills within an organisation. This is, however, a double bladed sword as even though the combined knowledge and skills of an organisation are expanded, it takes time which inevitably leads to productivity loss.

Finally this study investigates social networking, which is defined as the application of websites that support the maintenance of personal relationships, the discovery of potential relationships and should aim in the conversion of potential ties into weak and strong ties.

List of key terms: Information technology, productivity paradox, social networking, competitive advantage, knowledge expansion, development of human capital.

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LIST OF ABBREVIATIONS

EVA	-	Economic Value Added
ROI	-	Return On Investment
IT	-	Information Technology
OSI	-	Open Source Initiative

CHAPTER 1: ORIENTATION AND STATEMENT OF PROBLEM

1.1. INTRODUCTION

Technology forms an integral part of the individual's life, whether it be in professional or personal capacity. In the last few years the global society have witnessed the birth and rapid expansion of technology and information technology. Gordon Moore, co-founder of *Intel*, predicted in 1965 that the transistor density of semiconductor chips would double roughly every 18 months. This prediction had in actual fact came to fruition as we have moved through different generations of processors (Bocij, Greasly & Hickie, 2008:112). It is thus safe to assume that we are nowhere close to the conclusion of this evolution in any form or size and therefore have to be at peace with the effect and relevance thereof within the home and work place. Most to all individuals who occupy a professional career have to make use of some form of technology to aid in the ease and effectiveness of their occupation. This realisation lies at the crux of this study. The relevance of this cannot be denied in the workplace and it is thus of the utmost importance to study not only the known benefits (i.e. productivity) this practice holds, but also attempt to look beyond the seething stereotypical, well-rehearsed, conventional technological fountain of productive bliss. This one-directional stream of thought does not allow for any of the errors or side effects technology may hold for productivity and the workforce.

Information technology lets you plan and budget far more effectively than a piece of paper, and makes it possible to track people and production much easier than a conventional roster. It also simplifies communications by leaps and bounds and can draw from far more research sources than the largest collection of periodicals or books. This undeniably brings to reason that information technology should, and ought to, increase productivity.

With this reasoning in mind, some studies have shown that computers have had a positive impact on productivity in theory, but the reality remains that the productivity figures have not yet changed in practice. This anomaly (the realisation that productivity seems unaffected by the changes brought by the advances in computer science) is referred to as the “productivity paradox”. In answer to this anomaly, one would just have to look around at the work habits of oneself and other people to discover the degree to which time and productivity has been put to waste: for example, the memos with fancy borders and formatting, the well formatted presentations with sound effects and animations and many other similar examples, which all look very impressive but, in the end takes more time than those previously done on a typewriter.

Lately both large and small co-operations invest large amounts of money to expand information technology as a whole within their businesses and economy. This practice, however, has an alarming aspect to it: the seeming inability to accurately measure productivity, especially in light of the considerable financial investment made, for example when a company buys a new bore or heating oven, one can easily determine the return on investment (hereinafter "ROI") by simply calculating the earnings obtained by the increased productivity. This may prove to be a difficult calculation in the event that the exact definition and/or magnitude of what the term "productivity" means are not fully understood. One has to stand back and truly try and grasp what is seen as *productivity* within any given organisation.

ROI measures the organisation's overall effectiveness in using its assets to generate returns for common stockholders.

Productivity can be defined as the ratio of output to input for a specific production situation. Productivity changes can be caused by either movements in the ‘best practice’ production technology or by a change in the level of efficiency (Rogers, 1998:5).

The question of how productivity is measured is difficult when, for example, the company connects all their computers onto a network or installs an information system to keep record of customer information or even supplier information. It is difficult because, in this example, there is no input and output ratios that can be measured. In these cases, productivity is not so evident, and some might argue that it does not exist. Companies always look for the competitive advantage and it is therefore important to show whether investing in information technology does in effect produce a greater ROI.

This might raise the question as to why the implementation of information technology is important to increase productivity. The answer is obtained by looking at what all companies seek: sustainable growth. This according to Megginson, Smart and Graham (2010:697) can be measured by the accounting ROI, economic value added (EVA), and growth in sales or assets.

Some companies invested in information technology solely for the sake of implementing a new system in the hope that it will improve productivity, or increase ROI. This might never be the case for some of these companies, as they might have invested in the wrong information technology, or the technology they implemented does not improve their productivity, or that management has not yet adopted the necessary business processes in order to use the information system correctly. This phenomenon, called the "productivity paradox", puts these companies at a distinct disadvantage. This term was popularised by Strassman (1997), and seemed to suggest that there is little or no correlation between a company's investment in information systems and its business performance measured in terms of profitability or stock returns (Bocij *et al.*, 2008:112).

The primary objective of this study is to show what the impact of the so-called information technology productivity paradox in the heavy metal engineering industry is. Furthermore, this study will attempt to show the factors that might cause this phenomenon. Some secondary objectives are to show the correlation between information technology and ROI, and how to measure productivity in information systems.

1.2. IMPORTANCE OF THE STUDY

Productivity is imperative within an organisation, as this is how most organisations get return on investment (ROI). Productivity is easy to measure when one makes a physical product and sells it to a client, but it is not easy to measure the productivity, that is added, when the organisation is making use of a newly implemented information system.

When an organisation decides to implement a new information system, it takes a lot of time and money in order to get everybody trained to use the system and customize the system to fit the organisation's needs.

The importance of this study lies in an evaluation of the information technology productivity paradox in the heavy metal engineering industry. This study will look at the impact that the identified paradox has on the organisation, as well as the factors that cause this within an organisation.

1.3. PROBLEM STATEMENT

It has become extremely important for organisations to have the competitive advantage over their competitors. This competitiveness among organisations has resulted in information technology becoming one of the most important attributes in an organisation, as information is the key component to managing an organisation.

Within the heavy metal engineering industry management came across a problem, where even though there have been large investments in the expansion of information technology, it still seemed as if the productivity did not increase. This problem heralded the research topic at hand.

The intention of this research is to establish whether the information technology productivity paradox exists within the heavy metal engineering industry, with particular reference to establish which factors cause this anomaly.

1.4. CAUSAL FACTORS

The following considerations prompted this study:

a) The question why the productivity figures are not reflecting the necessary movement (after the implementation of information technologies);
b) The possible improvement in the financial results;
c) The costs associated with the implementation of new information technologies;
d) The time spent training individuals on new information technologies;
e) The profit loss due to technologies not complying with business processes;
f) The rapid speed at which information technology advances; and

g) The gaining of competitive advantages.

1.5. OBJECTIVES OF THE STUDY

The objectives of the study are split into primary and secondary objectives.

1.5.1. Primary objective

The primary objective of the study is to show whether the information technology productivity paradox in the heavy metal engineering industry does exist.

1.5.2. Secondary objectives

This study will focus on the factors that might cause the anomaly. In order to achieve the primary objective of the study, the following secondary objectives, based on both theoretical and empirical research, had to be realized:

- Theoretical evaluation:
  a) In order to gain a clear understanding of the subject matter a literature study was performed to research the factors that contribute to the productivity paradox;
  b) The correlation between productivity and return on investment was studied;
  c) The question as to the measurement of the productivity of information systems was researched;
  d) A high level assessment of the current status of the productivity paradox in the heavy metal engineering industry was performed.
- Empirical research:
  a) In order to examine the actual effect of information technology on productivity, the opinions of respondents on the nature of the productivity paradox in the heavy metal engineering industry were gathered;
  b) The factors' respondents highlighted in regards to the productivity paradox were investigated; and
  c) The correlation derived from the questionnaire between information technology and productivity, was established.

The impact of the productivity paradox is shown from both theoretical and empirical research. Lastly, recommendations will be made on how the factors, which realise the paradox, can be eliminated.

1.6. SCOPE OF THE STUDY

The research commenced at *DCD-DORBYL*, and from there on fanned out to other heavy metal engineering industries. The employees at the before-mentioned company were provided with questionnaires which they completed. The questionnaire contained questions pertaining to their habits during working hours with specific emphasis on whatever access they have to technology. This aspect of the research relied heavily on the honesty of the participants.

In addition to the questionnaires, the researcher also relied on interviews with the management of the different departments within the identified company(ies). The interviews primarily focused on:

a) Productivity statistics;
b) Money spent on technology and training;
c) The overall opinion of management regarding technology;
d) The technological framework used;
e) The success of implementation;
f) The time spent on training; and
g) Effective training versus successful use.

1.7. RESEARCH METHODOLOGY

Both primary and secondary sources were used during the study.

Secondary sources, which include, publications and textbooks, were used to study the different factors that play a role in and contribute to the information technology productivity paradox. Primary sources were gathered by means of an empirical study. A quantitative research approach was used in order to provide an objective base to meet the research objectives. Questionnaires were distributed to the relevant managers and specialists within the heavy metal engineering industry. All information that was obtained was kept confidential.

1.8. LIMITATIONS OF THE STUDY

With an empirical study, the researcher relied on the honesty of the participants. This, however, proved to be problematic as not many people were comfortable to divulge in details on their habits during working hours. Another minor setback to this study is that there is very little material available on this topic and the researcher will have to rely more on his opinion and interpretation of the findings based on the questionnaires and primary sources.

1.9. DIVISION OF CHAPTERS

- **Chapter 1**

  The purpose of this chapter is to discuss the causal factors and to confirm the problem statement that forms the foundation for this study. An overview is given into the use of information technology both for business and personal use. A glance is taken into the relationship between productivity and ROI of information technologies. The research methodology used is also discussed, as well as the limitations and scope of the study.

- **Chapter 2**

  Chapter two (2) consists of the literature study on the information technology productivity paradox and focuses on the impact that the productivity paradox has on the industries. The factors that lead to the paradox are discussed. The literature study includes ways of measuring productivity in information technology, and shows the correlation between ROI and information technology. In the literature study more evaluation methods are obtained in order to measure the impact that the paradox has.

- **Chapter 3**

  Chapter three (3) outlines the methodology used during the empirical study. The layout and design of the questionnaire used for the empirical study is discussed. Detailed analyses of the respondents' feedback are conducted and an evaluation, based on the results, is done on the information technology productivity paradox in the heavy metal engineering industry. Applications of the literature study on the findings of the empirical aspect of the research are conducted.

- **Chapter 4**

  Chapter four (4) presents a summary of the opinions from respondents within the heavy metal engineering industry on the information technology productivity paradox. Recommendations are made to address the factors relating to the paradox. Final recommendations are made to lessen the effects of the highlighted paradox.

1.10. CONCLUSION

Technology moves at such an alarming rate that it is not always clear as to whether a company should implement new systems or keep the older ones. This study strives to bring to light the relevance or need for cutting edge technology within the heavy metal engineering industries. Technology may lighten the work load of the employee, but the amount of idle time that is created as a result is still to be determined. This implies that money is spent by the organisation to increase productivity output, but the input by the employee is lessened. This is something to ponder as the employee will still receive the same salary at the end of the working month for less work done. When the amount of money spent is calculated in relation to the purchase and implementation of the new information technology together with the unchanging salary of the various employees involved, the numbers will doubtfully indicate a higher ROI. This is but one example of this paradox faced by many companies and organisations in the heavy metal engineering industries.

1.11. SUMMARY

Studies have shown that computers have a positive impact on productivity but, the reality remains that the productivity figures have not yet changed. This irregularity is referred to as the "productivity paradox".

The question of how productivity is measured is complicated when, for example, a company connects all their computers onto a network or installs an information system to keep record of customer information or even supplier information, for there is no input and output ratios that can be measured. In these cases, productivity is not so evident, and some might argue that it does not exist. Companies always look for the competitive advantage and it is therefore important to show whether investing in information technology does in effect give them a greater ROI.

The question of why it is important for information technology to increase productivity is answered by investigating what all companies seek, which is sustainable growth. This according to Megginson *et al.* (2010:697) can be measured by the accounting return on investment (ROI), economic value added (EVA), and growth in sales or assets. The goal of this study is to determine the impact of the information technology productivity paradox has on the heavy metal engineering industry whether it is good or bad.

CHAPTER 2: LITERATURE STUDY

2.1. INTRODUCTION

Throughout history the expansion and evolution of information technology has become more prominent, especially in the last few decades. Information technology has expanded to such an extent that more people are starting to rely on information technology in order to do their work, and to communicate with one another. This is what makes this study so important, especially from an organisational perspective, as they are spending more money on expanding their information systems. When an organisation makes an investment in information technology they expect the information system to either reduce costs or increase productivity.

The objective of this chapter is to review the literature on the information technology productivity paradox within the heavy metal engineering industry. The aspects that would be looked at in depth in order to get a better understanding of the concept are:

- The evolution of information technology and the laws that govern it;
- Knowledge expansion;
- The information technology productivity paradox;
- Open source systems;
- Development of human capital;
- Resistance to change; and
- Social networking.

The abovementioned aspects are all factors that relate to the information technology productivity paradox, and can more accurately be described as the contributing factors to the phenomenon.

Section 2.2 below will briefly discuss the history of information technology and how it has improved over the years. It also discusses the laws of information technology like, Moore's, Glider's, Metcalfe's and Less' law. Then the study investigates how human knowledge had to expand in order to keep up with the ever expanding information technology.

Section 2.4, dealing with the information technology productivity paradox, will attempt to define productivity and information technology. After a good understanding had been obtained of the two fields, the effects of information technology on productivity are discussed, in order to ascertain if the information technology productivity paradox does, in fact, exist. Thereafter the advantages and disadvantages of open source systems are discussed as well as the effect it has on productivity in information technology.

The development of human capital, which is a necessity for employees in an organisation in order to enhance both knowledge and skills within that organisation, is discussed in section 2.7 below. This is, however, a double bladed sword as even though the combined knowledge and skills of an organisation are expanded, it takes time which inevitably leads to productivity loss.

The final aspect is social networking. It is defined and both advantages and disadvantages are discussed. The impact that social networks has on productivity is also investigated.

There are many different views and opinions about the phenomena called productivity paradox. Some authors have published articles stating that this anomaly does not exist; however, there are also authors that published articles stating that this anomaly does exist. For this reason all of these aspects mentioned above will be discussed in detail in the sections to follow, in order to see whether information technology has an impact on the different aspects of an organisation with regards to productivity.

2.2. THE EVOLUTION OF INFORMATION TECHNOLOGY AND LAWS THAT GOVERN IT

Information technology is concerned with the use of technology in the managing and processing of information (Baltzan, Phillips & Haag, 2009:318). The Internet, personal computers, cellular phones with access to the web, personal digital assistants and presentation software are all well-known and effective components of information technology. These technologies are used to help perform specific information processing tasks.

Information technology is based upon two fundamental developments: hardware and software. Hardware consists of the physical devices associated with a computer system such as personal computers, laptops and handheld devices. Software is the set of instructions that the hardware executes to carry out specific tasks. In order to get a greater understanding of the effects of information technology on our lives and way of life, this section will focus on the evolution of information technology on the one hand, and the laws relating to it, on the other.

2.2.1. Evolution

Our history is speckled with the advances made by man in the field of information technology: From the basic abacus to the cellular phone in 4000 years! According to the Telecommunication and Film Department of the University of Alabama (1998), the history of information technology can be split into four basic periods. This division was used to sort and solve specific problems relating to and identifying the periods:

- The pre-mechanical age was between the years 3000 B.C. and 1450 A.D. In this age the first numbering system was invented as well as the first calculating tool, the abacus also know as a counting frame, the first information processor.
- The Mechanical age followed, and ranged between the years 1450 – 1840. This era heralded various inventions, such as the slide rules, the Pascaline and Leibniz's Machine. All of these inventions were a basic analogue computer.
- The Electromechanical age followed the mechanical age and ranged between the years 1840 – 1940. This era saw the conception of telecommunication and electromagnetic computing.
- The Electronic age (1940 to the present), saw the invention of the first generation computer between 1951 and 1958. This computer used vacuum tubes as its main logic elements, punch cards to input external store data, and rotating magnetic drums for internal storage of data and programs (programs written in machine language and assembly language which requires a compiler). The second generation computer was invented between 1959 and 1963. With these computers the vacuum tubes were replaced by transistors as main logic elements, magnetic tapes and disks began to replace the punch

cards as external storage device, magnetic cores strung on wire within the computer became the primary internal storage technology. The third generation computer was invented between 1964 and 1979. With these computers the individual transistors were replaced by integrated circuits, magnetic tapes and disks completely replacing punch cards, and magnetic core internal memories began to give way to a new form, metal oxide semiconductor (MOS) memory, which, like integrated circuits, used silicon-backed chips. The fourth generation was invented from 1979 and is being perfected to this day. These computers contained large-scale to very large-scale integrated circuits, microprocessors that contained memory, logic, and control circuits on a single chip (which allowed for home-use of personal computers).

The current uses, to name but a few, for information technology include the following:

- Animation for simulation of urban environments and video. This technology establishes an easy basis for visualizing the effects of urban growth and transformation.
- Graphic Information Systems for the study of housing and development patterns.
- Computer aided design for geometric modelling: information of the graphic information system is collected and primarily presented in a two-dimensional format. At the same time, three-dimensional modelling is important in demonstrating a more tangible and "real" simulation of familiar urban and topographic conditions.
- Storing data: this is done by the massive storage capacity available in computers systems.
- Automated processing: information technology allows for systems to automatically run processes and triggers.
- Work remotely: information technology allows for people to work on systems anywhere in the world.

2.2.2. Laws

From the above evolution and historical timeline it is evident that information technology has come a long way, especially in the last four decades. The first *Intel* processor 4004, which was designed in 1971, was used to run a calculating machine. The 4004 processor held 2300 transistors and the microprocessors circuit lines had a width of 10000 nanometres, compared to a human hair that has a width of 100000 nanometres. Currently *Intel's* newest processor, the Core i7 Extreme Edition, is used in high end computers designed for number crunching and gaming. This processor has 560 million transistors and the microprocessors circuit lines have a width of 32 nanometres.

Gordon Moore, the co-founder of *Intel*, made a statement forty years ago that the transistors on a chip would roughly double every two years. For the past few decades *Intel* has made the statement of Gordon Moore their mission and as a result, chips have decreased in physical size exponentially, but have also increased in capacity due to the increase in transistors (Moore, 2003:1; Pinto, 2002:1).

The microprocessors, referred to above have a forty year age gap, and the amount of transistors in the processors has multiplied by 243478 which is calculated by the number of transistors in the very first processer divided by the number of transistors in the current Intel processer. This means that *Intel* has multiplied the amount of transistors by 6086 each year. With this comparison it is evident that *Intel* has made Moore's law a reality (Intel, 2011).

George Gilder made a statement that, in total, communication systems would triple every twelve months. This definition is evident in the evolution of wireless Internet solutions. When looking at the bandwidth that cellular phone networks offered over the past decade, the definition, as set out by Gilder's law (Pinto, 2002:1), was also proven.

Robert Metcalfe stated that the value of a network is proportional to the square of the number of nodes. In other words as a network grows, the value of being connected to it grows exponentially, while the cost per user remains the same or even reduces (Pinto, 2002:1). This is evident in networks or the Internet today, where the value of information is far more valuable than costs involved with the network or Internet.

Less' Law states that although the actual storage capacity doubles, the price of storage is decreasing by half every 12 months. This even puts Moore's law to shame (Quon, 2004:1). This law is evident when one looks at the price of a new hard drive today. In comparison to a year ago, one can, for the same amount paid, get a hard drive of double the capacity.

From this section it is evident that the development of information technology has become very prominent in the past two to three decades. From the four laws of information technology it can only be deduced that the development of information technology will keep on evolving at an exponential rate, and can be seen as the multiplier effect.

As with the evolution of the information technology, knowledge also needed to expand in order to keep up with the fast progress that was made, especially in the last few decades. Knowledge expansion is discussed in detail in the next section.

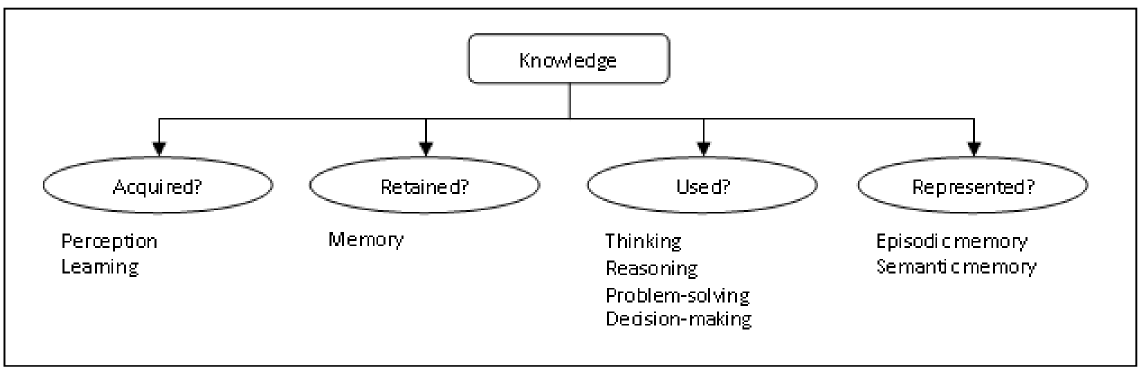
2.3. KNOWLEDGE EXPANSION IN THE APPLICATION OF INFORMATION TECHNOLOGY

In section 2.2 above the evolution and laws of information technology were defined and discussed. With this in mind, closer attention needs to be paid to knowledge and the expansion thereof. What makes science such a powerful tool is that it combines two ancient methods of attaining knowledge: rationalism and empiricism (Hergenhahn, 2005:6). The rationalist believes that mental operations or principles must be employed before knowledge can be attained. The empiricist maintains that the source of all knowledge is gained through sensory observation.

During the sixteenth century a philosopher by the name of Francis Bacon, a follower of the theory of empiricism, made a statement that science could and should change the world for the better. Science would furnish the knowledge that would improve technology, and improved technology would improve the world. As evidence of the power of technical knowledge, Bacon offered the inventions of printing, gunpowder, and the magnetic compass (Hergenhahn, 2005:104).

Knowledge, according to Bergh and Theron (2003:374), is a range of mental functions. A visual representation of the process is shown in Figure 2.1 below. The four distinct 'phases' in attaining knowledge are highlighted in the figure. Firstly, there will be a focus on how knowledge is acquired. It is done by perception and learning, the process by which new ideas and behaviours are acquired. Secondly, the question as to how knowledge is retained is examined: this is done by memory. Thirdly, they explored how knowledge is used, by means of thinking, reasoning, problem-solving and decision-making. Fourthly, it is important to know how knowledge is represented, and there are two categories of representation. The first is visual or auditory images, also referred to as episodic memory. Secondly, is semantic memory, which refers to abstract representations of the meaning of things, for example, our knowledge of mathematics and languages.

Figure 2-1: Processes of knowledge



(Source: Bergh & Theron, 2003:374).

When looking at the future and the rate at which knowledge grows, people tend to assume that the current rate of progress will continue in future periods. This however, when looking at the rate at which technology progresses, as stated in the previous section, is a misnomer for it is evident that the progress is not constant. It is, however, within human nature to become accustomed to the rate of change. It is thus plausible that the tempo will continue at the same rate as in the past. Those people, who have been around long enough to experience how the pace has increased over time, have perceived the rate of progress to have always been as it is now.

The rate of progress in the very recent past is far greater than that of ten years ago, and it is dominated by our most recent experiences. This is then typical for even the most sophisticated of observers, when looking at the future, to infer the current rate of change over the next ten years, or even a hundred years, to determine their expectations. This technique of looking at the future with the present as a reference is called the “intuitive linear” view, according to Kurzweil (2001:1).

Forecasts of technical feasibility in the future has been radically underestimated, as it is based on the “intuitive linear” view of progress rather than the historical exponential view. Another way of expressing this is, that people will not experience the next hundred years of progress in the twenty-first century, but will rather witness twenty thousand years of progress within the aforementioned century (Kurzweil, 2001:1).

Now that the term knowledge is defined and the different processes in the attainment thereof are understood, the focus should now be directed at the role of knowledge within organisations. "Organisational" and "Technical" knowledge are defined by Santos and Sussman (2000:432), as follows:

- Organisational knowledge necessarily includes knowing the answers to such questions as: Where is the organisation headed? What are the internal control mechanisms? What are the internal coordination mechanisms? How is our market changing? Which of our product lines are most vulnerable to changes in demographics, economic forces, or geo-political forces? What do we do well? What do we do poorly?
- Technical knowledge necessarily includes knowing answers to a different set of questions: What can be done with the technology? What will it cost? What are the technical risks? How difficult will it be for competitors to emulate what you may do and what will it cost them? Are there likely to be standards set in the future that will affect this application?

With this in mind, it is evident that knowledge, as applied to and understood within the heavy metal engineering industry is of the utmost importance as will be explained in the sections to follow.

2.4. THE INFORMATION TECHNOLOGY PRODUCTIVITY PARADOX

In this section the term "information technology productivity paradox" will be discussed. To completely comprehend the term one would need to look at the definitions of the components individually as well as the combined definition. In order to illustrate and define the paradox, attention is given to the factors that may contribute to this phenomenon.

In section 2.2 above, "information technology" was defined as, the use of technology in the managing and processing of information. The Internet, personal computers, cellular phones that access the web, personal digital assistants and presentation software that are components of information technology, are used to help perform specific information processing tasks. Information technology is based upon two fundamental categories: hardware and software. Hardware consists of the physical devices associated with a computer system. Software is the set of instructions that the hardware executes to carry out specific tasks (Baltzan *et al.*, 2009:318).

Productivity, on the other hand, has different meanings for different people, and this is why three categories can be identified. For the economists and engineers productivity is an efficiency measure. Efficiency in this definition is seen as the outputs over the inputs, where both in-and output are measured in monetary value. Within this definition an example of productivity would be the monetary value of a product over the monetary value of the cost to make the product. The second definition of productivity is both efficiency and effectiveness all together. With this definition an example would be not just the monetary value of the product, but the effectiveness, and the number of products made, as well. The third definition is the broadest and takes into account anything that makes the organisation function better. With this definition, not only is the efficiency and effectiveness taken into account, but also things like absenteeism, turnover, morale, and innovation (Pritchard, 1995:2).

Now that one knows what information technology and productivity is, one can look at the relationship between the two components and how it co-exists within the organisation. In the past four decades there have been great investments in information technology. The information technology spending in 2001 for the United States and Japan were $546,681 and $188,012 (in millions of US dollars), respectively (Lin & Shao, 2005:1).

In section 2.2 it is shown that information technology made enormous advances, and if history is a good indicator for what the future holds, it is easy to think that productivity should also increase (due to the advancements made and that which is still to come in information technology).

Despite the fact that the personal computers started to boom, and businesses spent hundreds of billions on purchasing office computers, there has been no payoff from this boom, because the productivity in the 1980s was no higher than that of the 1960s when compared (even though there were huge amounts of money spent on computers) (Bowen, 1986:20-21). The justification for this state of affairs was that the managers were still learning how to use the computers.

The term information technology productivity paradox seems to suggest that there is little or no correlation between a company's investment in information systems and its business performance measured in terms of profitability or stock returns (Bocij *et al.*, 2008:112; Oz, 2004:1). Solow (1987:36) stated strongly that, "you can see the computer age everywhere but in the productivity statistics", which he repeated about a decade later by stating that "there's not a shred of evidence to show that people are putting out more because of investment in technology".

In order to understand the paradox highlighted by Solow, one needs to look at what causes this phenomenon. Santos and Sussman (2000:431) stated that, the reasons for this anomaly can be categorised within two parts: failure in strategic thinking and failure of senior management to overcome resistance to change. Santos and Sussman (2000:431), listed the following reasons for the failure in strategic thinking:

a) The emphasis on information technology to improve current efficiencies assumes that the future will be the same;
b) The failure to view information technology as a catalyst for change (but rather as an efficiency tool);
c) Management sees technology as the domain of information technology professionals rather than developing psychological ownership of that technology, which is a closing shortcoming as managers are the only ones who are in a position to make the structural and strategic decisions; and
d) The lack of the necessary organisational and technical knowledge, as defined in section 2.3, to make the best decisions regarding IT deployment.

According to Brynjolfsson (1994:1), there are four more reasons for this anomaly within an organisation:

a) Mismeasurement of outputs and inputs;
b) Lags due to learning and adjustment;
c) Redistribution and dissipation of profits; and
d) Mismanagement of information technology.

Whenever a new information technology system is implemented or introduced, or a migration from one system to another is introduced, it is the responsibility of senior management to overcome the resistance to change, rather than amplify the classical resisting forces such as vested interest, fear of future, and adherence to the status quo. This resistance in itself is based upon a series of premises, which, ironically, within itself, suggest a paradox when compared to the reasons for the failure in strategic thinking. Santos and Sussman (2000:433), list the premises as follows:

a) Information technology represents a major corporate investment, an investment which necessarily command senior management's attention;
b) Senior managers are ultimately accountable for producing a return on that investment;
c) Senior managers would not be senior managers if they were oblivious to personal, political, and bureaucratic forces inhibiting change;
d) Over the years, they have witnessed many change efforts, some in which they were active participants, others in which they were interested bystanders; and
e) They ascended the hierarchy through their ability to champion change and overcome resistance to it.

In conclusion, the mentioned factors seem to be the most prominent factors that can lead to information technology productivity loss. There are, however, a few other factors that were not mentioned above that can also lead to the anomaly. These factors are discussed in more detail in the sections to come. Some of these factors are new technologies, open source systems, measuring productivity, development of human capital, and social networking.

2.5. THE IMPACT OF NEW INFORMATION TECHNOLOGIES

Information technology forms such an integral part of people's lives. Simple examples of these everyday uses are: automatic teller machines (ATM), global positioning systems (GPS) in motor vehicles, and cellular phones, just to mention a few. This is why it is important to know what can be expected in the near future with regards to information technology.

Section 2.2 showed that information technology has advanced at phenomenal rates, which leaves much to the imagination as to what the future holds for information technology. In order for companies to keep up to date they need to invest large amounts of money in information technology. Research had been done in order to indicate what can be expected in times to come. According to IBM research done in 2009 the top five trends are:

a) Reinventing the way computer systems are built;
b) Answering business needs with a “cloud”;
c) Social – and data – networking for the enterprise;
d) Real time information processing and analysis; and
e) Doing business anywhere, anytime.

Let’s look at these trends individually and focus especially on the impact that they might have on the organisation’s productivity (IBM Research, 2009):

- *Reinventing the way computer systems are built*. Every year it is expected that computers get smaller and use less energy. It is also expected that computers need to be faster and cost less. This doesn’t seem unreasonable and might as well be what expectations hold for the future (as was demonstrated in section 2.2). With the implementation of a reinvented computer system, there can be many things that can influence productivity. According to the IBM Research (2009:18), it can be assumed that the reinvention will not only affect changes to the hardware but the software as well (which includes the operating system and applications that the organisation might use). This means that in order for the organisation to implement new technology, it has to first do strategic planning. Some of the organisational level factors that might cause the productivity paradox in this case are as follows:

- Lags due to learning and adjustment, and
- Mismanagement of information technology.

- *Answering business needs with a "cloud" or Internet-scale data centre.* Cloud computing is a general term for anything that involves delivering hosted services over the Internet. These services are broadly divided into three categories: infrastructure-as-a-service, platform-as-a-service and software-as-a-service. As computer systems grow increasingly complex, particularly in cloud computing, it can be found that many are being used in unintended ways.
- *Social – and data – networking for the enterprise*. The Internet age brings with it tools that make forming communities and sharing information easier than ever. The wild success of social networking attests to the draw of online communities. These "community- and information-centric Web platforms," have tremendous potential for enterprises of all stripes as well. From the productivity paradox viewpoint lots of time can be lost when employees work on their own social network pages on company time.
- *Real time information processing and analysis*. In today's globally competitive business environment, information needs to be gathered, analysed and acted upon in real time. Failure to do so from a productivity paradox viewpoint, will amount to information technology to be seen as little more than an efficiency tool rather than a catalyst for change.
- *Doing business anywhere, anytime*. True wireless broadband is becoming a reality, and the power and capabilities of mobile devices are talking a quantum leap forward while prices decline, giving organisations the ability to work from anywhere at any time. This realisation could add to the anomaly as time can be lost due to mismanagement of information technology.

From the aforementioned points it can be deduced that when new information technologies are to be implemented, it can cause productivity loss if it is not implemented correctly. This, however, does not mean that new technologies are always the actual cause for these productivity losses. As indicated it is mostly human factors that cause productivity loss, due to either resistance to change or time spent on learning new systems. The only case where new technologies causes productivity loss is when management implemented the wrong system or the system has not been optimized for that organisation, which, in turn, amounts to human factors.

2.6. OPEN SOURCE SYSTEMS AND THE EFFECT IT HAS ON THE PRODUCTIVITY PARADOX

According to the Open Source Initiative (OSI) (2011:1), open source system is a method of development of software that harnesses the power of distributed peer review and transparency of process. Better quality, higher reliability, more flexibility, lower cost, and an end to greedy vendor lock-in, are some of the advantages that open sources offer.

The definition of open source, according to the Open Source Initiative (OSI) (2011:1) does not just mean access to the source code but needs to comply with the following criteria:

- Free Redistribution – There are no restrictions on any party from selling or giving away the software as a component of a combined software containing programs from several different sources. The license shall not require a royalty or other fee for such sale.
- Source Code – The source code must be included with the program, and must allow distribution in source code as well as compiled form. The source code must be the preferred form in which a programmer would modify the program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a pre-processor or translator are not allowed.
- A derived Works – Derived works and modifications must be allowed, and must allow them to be distributed under the same terms as the license of the original software.
- Integrity of the Author's Source Code – Distribution of modified source-code may only be restricted if license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

- No discrimination against persons or groups.
- No discrimination against fields of endeavour - The license may not restrict the program from being used in a business, or from being used for generic research.
- Distribution of License - The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.
- License Must Not Be Specific to a Product - The rights attached to the program must not depend on the program being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.
- License Must Not Restrict Other Software - The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open source software.
- License Must Be Technology-Neutral - No provision of the license may be predicated on any individual technology or style of interface.

There are advantages and disadvantages, to implementing open source software below:

- **ADVANTAGES**

a) Easing of licensing restrictions;
b) Cross-platform simplicity;
c) Possible to run modules on any operating system;
d) Low cost due to no licensing fees;
e) Modification of system is possible, as you have the source code; and
f) With the source available any bugs can be fixed.

- **DISADVANTAGES**

a) Certain open source systems are not fully developed as commercial software with similar functionality. This results in general lack of sophisticated tools for administrative purposes;
b) Lack of necessary expertise to do modifications, or do installations;
c) Open source systems can be less user-friendly than commercial software;
d) Support to the system is not always available; and
e) Security might be a problem as the source is available to everybody.

When discussing the above advantages and disadvantages there are a few points that might add to the productivity paradox. With the right expertise, the open source system could be modified in order to suit the company and increase productivity. There is also the easy licensing, which allows for the company to easily get access to the latest information systems. This might add to productivity as it might solve some of the drawbacks a previous system had. Open source systems can be compiled in order to run on cross-platforms, which means that regardless of which operating systems you are running in the company, whether it be low cost or not, the system can run.

Due to the less user-friendly interface, some of these open source systems might take longer to do the task than it would on the commercial software. If you do not have the necessary expertise the system might contain some security flaws that might put the company at risk. Implementation of the open source system might take longer than that of a commercial system as there might be a lack of support for the system. Some open source systems are not fully developed as the commercial software with the same functionality, this might add to the systems taking longer to do some tasks.

It is clear from the above that open source systems lack the necessary support in order to contribute to productivity, but if the correct expertise is hired in the company the systems might be easily fixed in order to improve productivity and it might be a more cost effective way of working (Cervone, 2003:1).

2.7. DEVELOPMENT OF HUMAN CAPITAL

The term “human capital” has been defined as a key element in improving an organisation's assets and employees in order to increase productivity as well as sustain competitive advantage (Marimuthu, Arokiasamy & Ismail, 2009:266). To sustain competitiveness in the organisation human capital becomes an instrument used to increase productivity. Marimuthu *et al.* (2009:266) also agree that processes like training, education and other professional initiatives are referred to as human capital, and is used to increase the levels of knowledge, skills, abilities, values, and social assets of an employee, which will lead to the employee's fulfilment and performance, and eventually the performance of the organisation.

Human capital, according to Son (2010:2), plays a critical role in economic growth and poverty reduction, and from a macro-economic perspective, the accumulation of human capital improves labour productivity; facilitates technological innovations; increase returns to capital; and makes growth more sustainable, which, in turn, supports poverty reduction.

From the above definitions, human capital refers to the ability and efficiency of people to transform raw materials and capital into goods and services, and that these skills can be learned through the educational system.

It is evident that human capital plays a great role within an organisation, and can thus be seen as one of the major factors contributing to the information technology productivity paradox, for the greatest part of human capital is the training and education of people (employees), which makes up the time lost.

2.8. RESISTANCE TO CHANGE

Section 2.4 highlights how significant investments in computer infrastructure have not been met with increases in employee productivity. Many have felt this phenomenon in their own business, because, after lots of money and time spent on training of staff, it seems as if it all goes backwards as the systems gets learned.

As a result of the implementation of new information technology resistance may occur. In order to assist in overcoming the resistance and shorten the implementation- and learning-phase, one has to spend one's efforts on the following activities:

a) Involve the supervisors and general worker, and get input into the design and processes of the new system and its implementation. They won't take ownership of the system at the end if they have not been involved from the beginning.

b) Before commissioning the system, roles and responsibilities need to be clarified. Specify who will be responsible for maintaining input and integrity of data. What reports need generating and who should take responsibility for them?
c) Process flows and new procedures need to be put in place before the commissioning of the new system. Make sure that everybody involved get them and that they understand them.
d) Make the training highly relevant, practical rather than theoretical. Give them a live system to work on.

Even if all of these steps were taken, it is not to say that it will work. When the proposal is done, adequate preparation is necessary. Crystal clear objectives need to be set, and a baseline measure must be taken before implementation.

Some executives act as if almost any problem can be made to go away by throwing some new technology at it. Nothing could be further from the truth. Human systems need to be congruent with the new information technology before it can be used productively by employees (Allan, 2011:1).

2.9. SOCIAL NETWORKING

This section will discuss the effects that social networking has on an organisation and how it contributes to the information technology productivity paradox. From previous sections it was shown that information technology forms an integrated part of people's lives. With social networking forming part of the new technologies mentioned in Section 2.5 it is only a matter of time before everybody starts using social networks.

Social networks, according to Van Zyl (2008:909), can be defined as the application of websites that support the maintenance of personal relationships, the discovery of potential relationships and should aim in the conversion of potential ties into weak and strong ties. In other words, social networks provide a platform for people to meet other people on the Internet and then socialise within groups or one to one.

Van Zyl (2008:910-911) cites the following advantages of social networks:

- Social networking provides users with the ability to create a list of contacts, of people with whom they have strong professional ties, co-workers, colleagues and people they do business with, who they trust enough to be associated with and even recommend to others.
- Users can also share their current activities, interest, specialist skills and expertise. By sharing this information it makes it easier for organisations to find people suitable to work for them.
- Social networking within an office allows for a collaborative learning environment, in which problems encountered are collectively solved and solutions are shared among peers, bridging the gap between procedures and practice.
- Social networks can help organisations to create an online resource containing the accumulated wisdom of the organisation, by allowing knowledge to be documented, searched and shared.
- Productivity and workflow are often hampered by the use of e-mail and instant messages and telephone calls. By the use asynchronous communication such as blogs and wiki's and decreasing the use of e-mails and other disruptive communication methods, an increase in productivity and work flow efficiency can be obtained.
- Social networking can be used as a marketing tool, where people are encouraged to pass marketing messages on through word-of-mouth. These promotions may include video clips, flash games, e-books, free software, images and text messages.

Van Zyl (2008:913-914) highlighted the following disadvantages:

- Social networking allows people to gain access to a large volume of information, which can then be used in a social engineering attack.
- Fake profiles, blogs and other networking tools, can contain links to websites that download unwanted spyware.
- Productivity will be affected negatively because employees may spend too much time networking and posting entries on blogs and wiki's. There is also

the risk that employees will utilise it more for social purposes and not for work related postings.

- Knowledge is no longer created in controlled hierarchical groups. Anybody could add and edit content, including unanticipated players who are not subject matter experts.
- Many employers are concerned about the potential loss of confidential information by an unguarded comment or link created by an employee, which could then lead to financial damage, legal liability or possible security risks.
- Staff posting negative comments about their organisation, clients and colleagues online can become easy to fine via an online search and may be available for an unlimited time.
- Former or dissatisfied customers can criticise and complain about the organisation creating a public image of a organisation which is outside the organisation's control.

From the abovementioned advantages and disadvantages it is evident that social networking has a great impact on an organisation. Without the right regulations and guidelines it can lead to productivity loss. This explains why social networks can be seen as one of the main reasons for the information technology productivity paradox within an organisation.

2.10. MEASURING PRODUCTIVITY

This section will focus on the measurement of information technology productivity. This is a very important measurement as many companies invest in information technology in order to gain competitive advantage over their competitors. With information technology, or as Strassman terms it, information management, as a resource of greater economic leverage, attention will be shifted towards the measuring of information technology productivity. Urgent questions like whether information technology increases productivity will need to be answered (Strassman, 2004:19).

According to Strassman (2004:6), capital is no longer the most important economic input for a modern corporation, for it is readily available at a competitive price. Strassman argues that the most important assets of a corporation are people, and the management of information needed to support those people now greatly exceeds the costs of capital.

The most common ways to measure an organisation's productivity are methods such as return on assets (ROA), return on shareholders' equity (ROE) or return on shareholders' investments (ROI). These methods, according to Strassman (2004:6), are not valid for evaluating information investments. Strassman argues that information value-added (IVA) is a better measure of the economic contribution of corporate information management than accounting profits.

In previous sections the term productivity was defined as the ratio between "Output" and "Input", as with normal productivity; when measuring the information technology or information management productivity one would look at the ratio between output and input. *Output* in this case is the economic value of information resources and the *Input* is the economic cost of information resources. Therefore we can say that Output = Information value-added, and Input = Transaction costs. The ratio of information value-added / transaction costs then defines information productivity (Strassman, 2004:19-20).

In order to calculate the information value-added one needs to subtract all economic costs like land, cost of goods, compensation for shareholder capital, taxes and costs of information management from the profit after taxes. The residual that is left is the information value-added, as can be seen in Equation 2-1 below.

Equation 2-1: Calculation of information value-added

IVA = Profit - Cost of Ownership of Capital Where: Profit = Accounting profit after taxes and before preferred dividends but prior to special charges and adjustments. This is the income of a company after all expenses, income taxes, and minority interest, but before provisions for common and/or preferred dividends. Cost of Ownership of Capital = Cost of Capital * Capital Where: Cost of Capital = Expected rate of return as determined by the capital asset pricing model. Capital = Shareholder equity.

(Source: Strassman, 2004:27).

The computation of information productivity depends on getting the costs of information approximately right. My definition of information costs is very broad. It includes all costs of managing, coordinating, training, communicating, planning, accounting, marketing and research. Economists apply the term "transaction costs" to those categories. We will adopt this term as the most descriptive way to deal with diversified set of cost elements. Unless an activity is identified as a direct expense associated with delivering to a paying customer a product or service it will be classified as a transaction expense.

Activity-based costing methods are particularly useful in separating cost elements that are directly related to the production of customer value from those that are engaged in support. This method employs a disciplined and standardized approach to cost analysis. In this approach analysts fill out forms that reveal all the costs according to a prescribed method for separating the direct costs of operations from the supporting costs.

From the abovementioned it is evident that one can measure information productivity. It is important to have an accurate estimate of the "transaction costs" as set out by the economists' definition of the term. It is important to measure information productivity as it is beginning to become more important than capital.

2.11. CONCLUSION

The development of information technology has become very prominent in the past two to three decades. From the four laws of information technology it can only be deducted that the development of information technology will keep on evolving at an exponential rate.

As with the evolution of the information technology, knowledge also needed to expand in order to keep up with the fast progress that was made by information technologies. With this in mind, it is evident that knowledge, as applied to and understood within the heavy metal engineering industry is of the utmost importance. The development of human capital is nothing more than the expansion of knowledge. This, in turn, can be seen as one of the major factors in the information technology productivity paradox. As the greatest part of human capital is training and education of employees in an organisation, therefore it is easy to deduce that it could cause productivity loss due to time spent on training, and, in some instances, retraining.

With the implementation of new information technologies, it can cause productivity loss if it is not implemented correctly. This however does not mean that new technologies are always the actual cause for these productivity losses, as there are other factors at play. As indicated in the section above it is mostly human factors that cause productivity loss, due to either resistance to change or time spent on learning new systems. The only case where new technologies cause productivity loss is when management implemented the wrong system or the system has not been optimized for that organisation.

In regards to open source systems the lack of basic maintenance and support may lead to productivity loss, but if the required knowledge is obtained in order to sustain the open source system, it might improve the productivity and be more cost effective than a licensed system.

Social networking has many advantages and disadvantages, and it is evident that the previously mentioned has a great impact on an organisation. Thus without the proper regulations and systems in place, social networking can lead to major productivity loss. This shows why social networking can be seen as one of the main contributors to the information technology productivity paradox within an organisation.

It is furthermore evident from the discussion that it is possible to measure information productivity. It is important to have an accurate estimate of the "transaction costs" as set out by the economists' definition of the term in order to accurately measure productivity.

In conclusion to this chapter the above mentioned factors seem to be the most prominent factors that can lead to information technology productivity loss. Given the literature study it is shown that the information technology productivity paradox does exist. This can have a great effect on competitive advantage, as competitive advantage relay on two important aspects, capabilities and resources, which both need productivity to increase in order to obtain lower cost or develop differentiated products.

2.12. SUMMARY

Information technology has expanded to such an extent that more people are starting to rely on information technology in order to do their work, and communicate with one another. This is what makes this study so important, especially from an organisation's perspective, as they are spending more money on expanding their information systems. The aspects that are dealt with in this chapter were as follows:

- Evolution of information technology and the legislation that governs;
- Knowledge expansion;
- Information technology productivity paradox;
- Open source systems;
- Development of human capital;
- Resistance to change and;
- Social Networking.

Firstly, the evolution pertains to the history of information technology, and how it has improved over the years. It also discusses at the laws of information technology like, Moore's, that explains that the transistors on a chip would roughly double every two years, and Glider's that explains in total communication a system triples every twelve months.

Secondly, this chapter is concerned with the knowledge expansion and how human knowledge had to expand in order to keep up with the ever escalating information technology. When looking at the future and the rate at which knowledge increases people tend to assume that the current rate of progress will continue in future periods. This however, when taking into account the rate at which technology progresses, is evident that the progress is not constant.

Thirdly the information technology productivity paradox investigates productivity on its own as well as information technology on its own, where productivity is defined as the ratio between input and output, and information technology is defined as the use of technology in managing and processing information. The term information technology productivity paradox suggests that there is no correlation between a company's investment in information systems and its business performance measured in terms of productivity. This phenomenon was shown to exist within this chapter.

The fifth topic is that of open source systems. This system is a method of development for software that harnesses the power of distributed peer review and transparency of process. Open source systems have the following advantages like easing of licensing restrictions, cross-platform simplicity, possibility to run modules on any operating system, low cost due to no licensing fees, modification of system is possible and disadvantages like lack of necessary expertise to do modifications, less user-friendly, support is not always available, and security might be a problem.

In this way open source systems will affect productivity in information technology due to the less user-friendly interface, some of these open source systems might take longer to do the task than it would on the commercial software. Implementation of the open source system might take longer than that of a commercial system as there might be a lack of support for the system.

The sixth aspect investigated is the development of human capital, which is a necessity for employees in an organisation in order to enhance both knowledge and skills within an organisation. This is, however, a double bladed sword as even though the combined knowledge and skills of an organisation is expanded, it takes time which inevitably leads to productivity loss.

Finally, this chapter discussed at social networking, which is defined as the application of websites that support the maintenance of personal relationships, the discovery of potential relationships and should aim in the conversion of potential ties into weak and strong ties. An advantage of social networking is that social networking can be used as a marketing tool, where people are encouraged to pass marketing messages on through word-of-mouth. These promotions may include video clips, flash games, e-books, free software, images and text messages, but a disadvantage is that productivity will be affected negatively because employees may spend too much time networking and posting entries on blogs and wiki's. There is also the risk that employees will utilise it for more social purposes and not work related postings.

CHAPTER 3: EMPIRICAL STUDY

3.1. INTRODUCTION

The literature study in chapter two showed that the productivity paradox does exist. The empirical study is focused on the impact of the information technology productivity paradox in the heavy metal engineering industry of the South African society, which was done by means of a field study using a structured questionnaire. The questionnaire (Appendix A) was structured in such a way that the statements and conclusions within the literature study of chapter two were verified for validity, correctness and to see if the literature portraits the actual sentiments in practice. By means of a questionnaire this study will determine if the information technology productivity paradox exists within the heavy metal engineering industry, and what are the differences between the literature study and in actual practice.

This chapter aims to set out the background to the design of the questionnaire, the processing of the data and the results of the field study. This chapter begins with the problem statement as set out in chapter one, and continues with the research design which includes the study population and sample, the research procedure and measuring instrument. The second part of the chapter is aimed at the analysis of the data gathered and the results obtained.

3.2. THE RESEARCH PROBLEM

The intention of this study is to establish, whether the information technology productivity paradox exists within the heavy metal engineering industry, with particular reference to which factors cause this anomaly. There are different research types which are determined by the nature of the research. These types are:

a) Exploratory: Initial research conducted to clarify and define the nature of a problem.
b) Descriptive: This type of research is designed to describe the characteristics of a population or phenomenon which can be qualitative or quantitative in nature.

c) Casual: This type of research is defined as a cause and effect relationship among variables when the research problem has already been narrowly identified.

The study at hand will be achieved by answering the following research objectives:

a) In order to examine the actual effect of information technology on productivity, the opinions of respondents on the nature of the productivity paradox in the heavy metal engineering industry were gathered;
b) The factors respondents highlighted in regards to the productivity paradox were investigated; and
c) The correlation derived from the questionnaire, between information technology and productivity, was established.

In order to establish the abovementioned objectives, this study will be aimed at any user of information technology within the heavy metal engineering industry of South Africa, which will be done using a descriptive research method that can be measured both qualitatively and or quantitatively.

3.3. EMPIRICAL STUDY

The process of scientific research involves several stages, by using scientific methods and procedures in each of these stages, one acquires "knowledge" which explains the mystery of certain phenomena. Scientific knowledge has three core features: it is obtained by means of systematic observation, control is exercised in the process of obtaining the information, and the results can be replicated. Non-scientific knowledge, on the other hand, is obtained by means of authority, opinions of peers, traditions, debating, and accidental observations. We can distinguish between two methodologies: the quantitative and qualitative methodologies. These research methodologies allow one the means to explore unexplained phenomena as well as those which were previously explained but misunderstood. Through the use of methods and techniques that are scientifically defendable, we may come to conclusions that are valid and reliable. Quantitative research uses structured methods to evaluate objective data, whereas qualitative research uses more flexible methods to investigate subjective data (Welman Kruger and Mitchell, 2005:9). This study will only be using a quantitative methodology, as the research topic is very sensitive and from a pilot study done the researcher found that the respondents were biased with a qualitative methodology.

3.3.1. Research design

The general approach to the research is known as our research paradigm, which refers to the progress of scientific practice based on people's philosophies and assumptions about the world and the nature of knowledge (Welman, *et al.*, 2005:13).

The purpose of research design is to plan and structure a research project in such a way that it enhances the validity of the research findings. In order to obtain the research objective set out in chapter one, a survey design was used. The technique used for the collection and gathering of data for this survey was done by a questionnaire. The distribution of the questionnaire is discussed in more detail in the section to follow.

3.3.2. Study population and sample

The population is the study object and consists of individuals, groups, organisations, human products and events or conditions to which they are exposed. It is difficult with research to question every member of the population involved. The total population in question is termed the sampling frame and the individuals within the population are called the sampling units (Welman *et al.,* 2005:52-56). There are two different types of sampling: probability (random) and non-probability (non-random). A sample is a subset from a larger population, and this enables the researcher to estimate some of the unknown characteristics of the population.

The decision about the size of the sample can be very complex and can be influenced by the population characteristics, research objectives, time, statistical precision and judgement (Welman *et al.,* 2005:70). In order to meet the research objectives, the sample size were selected based on a required accuracy of 10 percent at a 90 percent confidence level, taking into consideration the size of the population, the variance of the variable and the units of analysis.

Equation 3-1: Sample size

$$n = \frac{Z^2\pi(1 - \pi)}{e^2}$$

$$new\ n = \frac{n}{1 + (\frac{n}{N})}$$

Where:

n = sample size given parameters and infinite population

new n = sample size required taking into account population size

Z = number of standard deviations for given accuracy (1.96 for 95% confidence level)

π = proportion of sample of interest (a value of 0.5 maximises the sample size, thus minimising the error)

e = error allowable, in this case 10%

N = population size

The population can be seen as the heavy metal engineering industry in South Africa. This study is however limited to the borders of South Africa and in a sense also limited to the part of the population that could be reached. An availability sample was identified from all the heavy metal engineering industries and consisted of all the employees that work with information technology and has an e-mail address. This questionnaire was sent to 744 people, the number of replies according to **Equation 3-1** needed for the analysis should be 85. The number of replies received from the population, were 129 and these participants form the sample (n) that will be analysed in this chapter. Table 3-1 contains a list of companies that form part of the population that received e-mails:

Table 3-1: Mailing list of companies

COMPANY NAME
DCD-DORBYL Heavy Engineering Vereeniging
DCD-DORBYL RSD
DCD-DORBYL VENCO (Newcastle)
DCD-DORBYL MARINE
DCD-DORBYL RINGROLLERS
ELGIN ENGINEERING
KAPPA HEAVY ENGINEERING (Pty) Ltd

3.3.3. Descriptive statistics

In order to analyse the data collected from the respondents in the survey, there are some attributes of descriptive statistics that firstly needs to be explained such as:

- Measure of a mean value;
- Effect size;
- Measure of standard deviation for the mean;

The mean value is the most common measure of central tendency. If one represents the individual numbers with an x and n represents the number of items, the equation for calculating the mean is as follows:

Equation 3-2: Mean calculation

$$Mean = \frac{\sum x}{n}$$

Where:

$\sum x$ = the sum of all the individual numbers.

n = the sample size.

The effect size is independent of the sample size and measures the practical significance. The effect size shows whether there is a significant difference between means, for the relationship in two-way frequency tables and also for a multiple regression fit. The equation for the effect size can be seen in Equation 3-3.

Equation 3-3: Effect size

$$d = \frac{|(x_1 - x_2)|}{s_{max}}$$

Where:

$|(x_1 - x_2)|$ = the absolute difference between two means.

S_{max} = the maximum estimate for standard deviation.

The correlation coefficients (r) can also be viewed as the effect size and for the purpose of this study is used to determine the significance of the relationship between variables.

Standard deviation for population is the square root of the sum of the squared differences around the mean divided by the sample size. In order to calculate the standard deviation the following equation is used:

Equation 3-4: Standard deviation for population

$$SD = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$$

Where:

x = the individual data items,

$\bar{x}$ = the mean,

n = the sample size.

Standard deviation for a sample is the square root of the sum of the squared differences around the mean divided by the sample size minus one. The formula for calculating the standard deviation of the sample is slightly different from that of the population as shown below:

Equation 3-5: Standard deviation for sample

$$SD = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

The only difference between the equation for sample and population is then divided by (n – 1) and not (n).

3.3.4. Measuring instrument

The measuring instrument consisted of a questionnaire specifically compiled for the employees using information technology within the heavy metal engineering industry. The questionnaire was compiled taking into account the primary and secondary objectives set out in chapter one. The objectives in chapter one were incorporated and aligned within the objectives of the questionnaire. The main objective of this study is to get an understanding of the impact that the information technology productivity paradox has on the heavy metal engineering industry of South Africa.

The questionnaire was distributed through e-mail to all heavy metal engineering companies in South Africa, to gather data. All employees, at the different companies, that physically work with information technology daily requested to complete the questionnaires. Questionnaires were received and used in the empirical study.

The purpose for researching the impact of the information productivity paradox in the heavy metal engineering industry of South Africa is to understand and determine the actual reason behind this phenomenon; determine if there is a solution that can be implemented in order for companies to get better return on investment with regard to the implementation of new information technology systems.

It is evident through the literature review that there exists major benefit from information technologies to companies and society: from increased productivity; increased cost efficiency; increased quality of service delivery and products to increased economic benefits for society at large.

3.3.5. Research procedure

The measuring battery was compiled. A letter motivating the research was included. The questionnaire also included a brief explanation of the purpose of the questionnaire and the reason for the study. Instructions on how the questionnaire should be answered and details on when and how the questionnaire should be returned were provided. Informed consent from participants was implicitly given through their participation in the completion of the questionnaire.

3.4. DATA ANALYSIS

The statistical analysis was conducted with the assistance of the Statistical Consultation Services of the North-West University by means of Statistical Package for the Social Sciences Incorporated (SPSS Inc.) version 18 of 2009.

The data gathered was analysed using descriptive and inferential statistics (t-tests) in order to reach the objectives of this study. Descriptive statistics is about collecting, summarizing and presenting data into meaningful information, and is presented and discussed in the sections to follow.

3.4.1. Biographical information of respondents

Within the questionnaire (refer to Appendix A) in Section A the respondents were asked biographical information in order to get a good understanding of the demographic detail. For the purpose of this study the split in the demographic will be as follows:

Table 3-2: Compilation of sample of employees

Item	*Category*	*Frequency*	*Percentage*
Gender	Female	28	21.7
	Male	101	78.3
Age	21 - 30 years	47	36.4
	31 - 40 years	42	32.6
	41 - 50 years	23	17.8
	51 - 60 years	16	12.4
	61 years and older	1	0.8
Social Networking Account	Yes	67	51.9
	No	62	48.1
Level of Education	No Matric	1	0.8
	Matric	31	24.0
	No tertiary qualifications	14	10.9
	Associated Diploma	27	20.9
	Bachelor's Degree	26	20.2
	Honour's Degree	13	10.1
	Master's Degree	17	13.2
Capacity or Role of use	As Employee	61	47.3
	As Management	68	52.7
	For Personal use	82	63.6
	For Studies	63	48.8
Personal e-mail account	Yes	73	56.6
	No	56	43.4
Cellular phone setup for social media	Yes	125	96.9
	No	4	3.1

From Table 3-2 the following conclusion can be made: it can be stated that the study population was represented by a majority of males, it can also be deduced that the majority of the study population fall within two age categories ranging between 21 - 30 years having 36.4% of the population and 31 - 40 years having 32.6% of the population making up 69% of the population. One can also infer that the level of education within the study population is quite evenly distributed from Matric through to a Master's degree, and that the role or capacity in which the study population uses information technology is the majority in management with 52.7%. Finally one can deduce that 96.9% of the study population has a hand held device capable of making use of either e-mails, short message service or social networking services. For a summary of the response table refer to Appendix B.

3.4.2. Exploratory analysis

In analysing the data there are various statistical significance tests that are used in order to indicate whether there is a significant difference between the values being tested, these significance tests are discussed in sections to follow. One of the decisive factors in the significance test is the p-value. A small p-value (eg. smaller than 0.05) is considered as sufficient evidence that the result is statistically significant. This does not, however, imply that the result is important in practice as these tests have a tendency to yield small p-values as the sizes of the data set increases (Ellis & Steyn, 2003:51).

Note that, since the sample in this study is a convenience sample and not a random sample, the p-values that attempt to generalize findings to the population is actually not relevant. The data in the sample should be seen as a small population about which conclusions are drawn, rather than using statistical inference to generalize to the study population. In this case effect sizes can then be used to test for differences that are practically significant. Practical significance can be understood as a large enough difference to have an effect in practice (Ellis & Steyn, 2003:52 - 53). In this study, both p-values and effect sizes are presented for the sake of completeness. It is important to note that the emphasis should fall on effect size and practical significance. Within this study the test were performed with the effect sizes as given by Cohen (1988) as guidelines for the interpretation of the effect sizes:

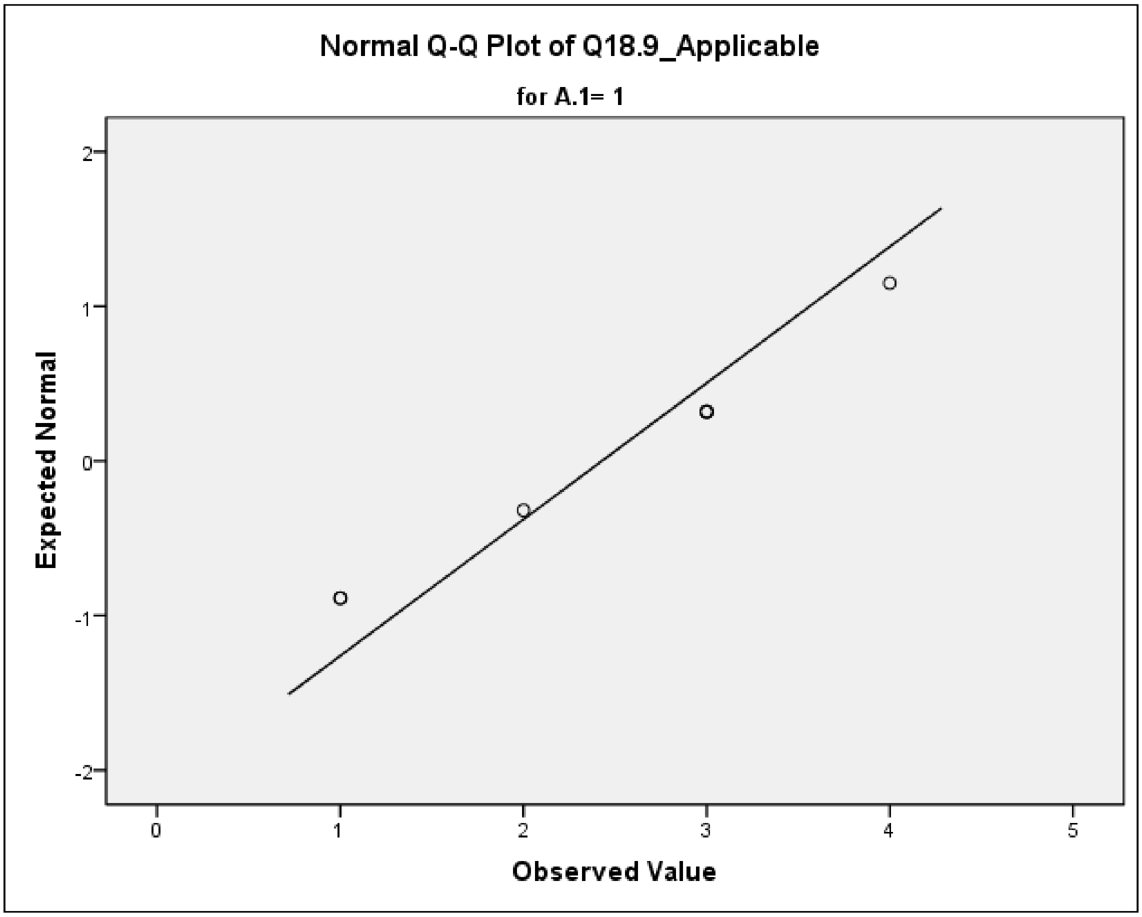
Table 3-3: Interpretation table for practical significance

Aim	*Test*	*Effect size*	*Small*	*Practically visible (Medium)*	*Practically Significant (Large)*
Correlation / Assessment between 2 questions	Spearman's rho (Non-parametric)	r	(±) 0.1	(±) 0.3	(±) 0.5
Comparison of 2 means	Independent T-Test (Parametric) Mann-Whitney (Nonparametric)	d	0.2	0.5	0.8
Comparison of groups (categories)	Cross Tabs Chi-square (Nonparametric)	Phi (2x2) Cramer's V	0.1	0.3	0.5

Parametric tests are used to investigate the statistical significance in differences between group means. These tests are only valid under the assumptions of observations are independent, observations was drawn from normally distributed populations, and the population must have the same variance. Nonparametric tests, on the other hand, are less sensitive to deviations from normality and homogeneity of variance. Nonparametric tests protect against some violations of assumption and not others. The two sample t-test, a parametric test, requires four assumptions, interval data, normality, equal variance and independence for data. More precise information can be obtained by performing one of the tests of normality to determine the probability that the sample came from a normally distributed population of observations. In order to test for normality one will make use of the Kolmogorov-Smirnov test and the Shapiro-Wilk test. However, these tests become sensitive to small deviations from normality as the sample size gets larger (p-value), as such QQ-plots were used to evaluate the severity of deviation and potentially overrule the

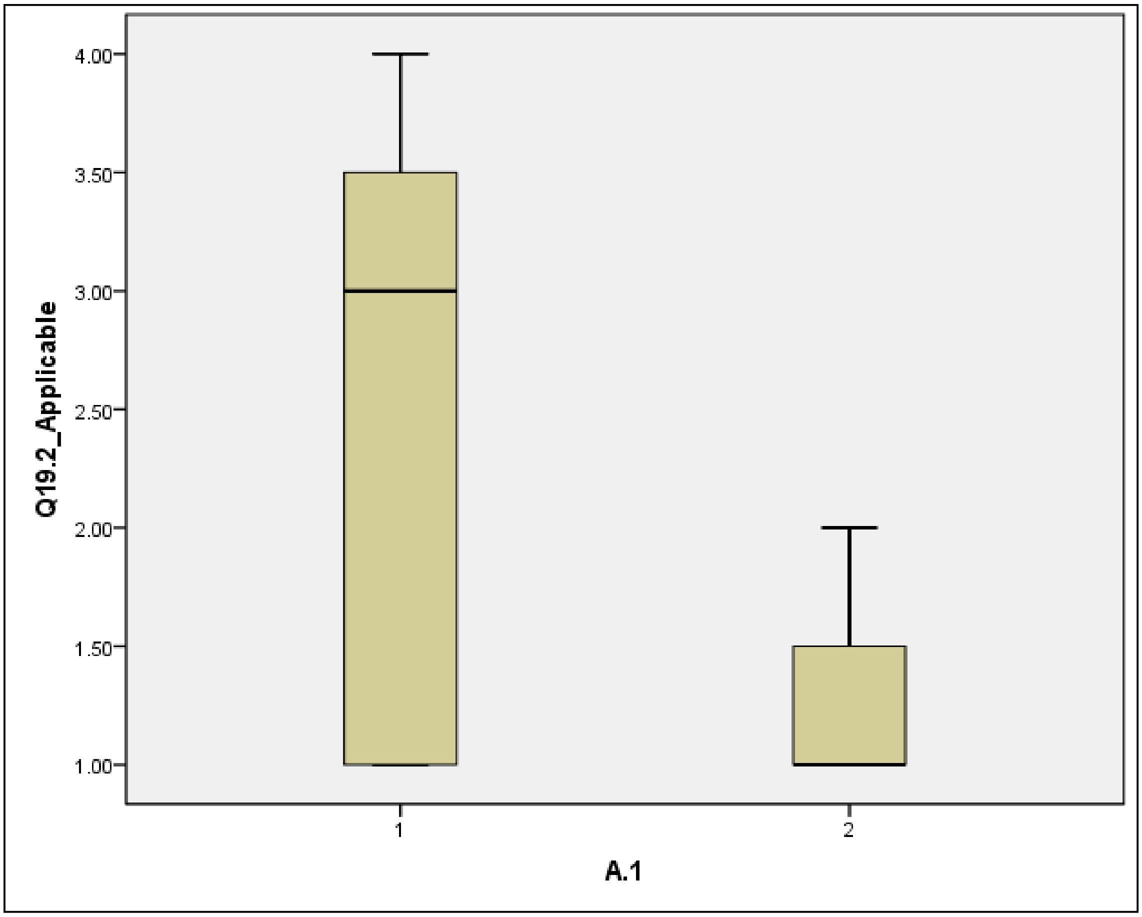
Kolmogorov-Smirnov and Shapiro-Wilk tests. The Kolmogorov-Smirnov and Shapiro-Wilk tests rejected normality for the majority of data collected with p-values of less than 0.05. However, the QQ-plots as shown in **Figure 3-1** show no severe deviations.

Figure 3-1: QQ Plot



In order to test for constant variance between groups Levene's test were used, the data was rejected ($p \leq 0.05$) in some instances. However, the test can also be overly sensitive as the sample size becomes large, therefore the independent t-test (equal variance not assumed) was used. The data collected shows relative differences in variance as shown in the Box-and-Whiskers Plot in **Figure 3-2**.

Figure 3-2: Box-and-Whiskers Plot



Both the parametric and nonparametric tests were performed for each test within this study. As the p-value is very sensitive to the sample size, one needs to rely on the graphical representation of the values in order to measure whether there are any severe deviations within the data.

3.4.3. Data correlations

In order to test whether there are any correlations between different questions, the Spearman's rho correlation method was used. This method would also point out any level of significance.

The reader should take note that within this study the "Not Applicable" option in Question 18 and Question 19 was dropped in order to use these questions within the correlation analysis. From the correlation analysis done on the data collected for this study, there are a few correlations that need to be highlighted. These correlations fall within different categories and are listed below:

- **Use of Internet access**

Question B.16.4 (Whether people share the Internet with others at work) and C.21.2 (time spent on personal e-mails) is statistically significant and has a medium relationship ($r = 0.342$; $p = 0.000$), which means that respondents showed a medium tendency to spend more time on personal e-mails when they share Internet access with others at work.

- **Training and use of systems**

The correlation between question B.17.1 (frequency at which spreadsheets are used in order to do your work) and C.28.1 (level of skill for using spreadsheets) is statistically significant and has a strong (large) relationship ($r = 0.760$; $p = 0.000$), which means that the respondents showed a strong tendency to be more skilled in spreadsheets the more they have to work with spreadsheets.

There are also a correlation between B.17.2 (frequency at which presentation software is used in order to do your work) and C.28.2 (level of skill for using presentation software) is statistically significant and has a strong (large) relationship ($r = 0.624$; $p = 0.000$). From this it can be deduced that the respondents showed a strong tendency to be more skilled in presentation software the more frequently they have to use it for work.

A correlation also exists between question B.17.4 (frequency at which the Internet is used to search for information) and C.28.4 (skill level in using the Internet effective and efficiently to search for information) and statistical significance was found. There also exists a strong (large) relationship ($r = 0.569$; $p = 0.000$). It can be deduced that the respondents show a strong tendency to be more skilled in Internet searches the more frequent their use of the Internet is to do searches for work.

There also exists a strong (large) relationship between the frequency that respondents use enterprise resource planning systems and the level of skill in enterprise resource planning systems. This is evident in the correlation between question B.17.5 (frequency at which enterprise resource planning is used) and C.28.5 (level of skill in working with enterprise resource planning), which is statistically significant with a strong relationship (r = 0.746; p = 0.000).

- **Use of and time spent on handheld device**

Question C.21.1 (time spent on handheld device daily) and question B.19.3 (use of social networking to find out more about people), has statistical significance and there exists a medium (fair) relationship (r = 0.337; p = 0.000). This shows that the respondents have a tendency to use their social networking account to find out more about other people when spending more time on their handheld devices, that is, if they do have a social networking account and a handheld device capable of utilising social networking.

There is also a correlation between question C.21.1 and question B.19.4 (use social networking in order to express one's opinions and views), which has statistical significance, with a medium (fair) relationship (r = 0.303; p = 0.016). What one can deduce from this is that the respondents have a tendency when spending more time on their handheld device, to use their social networking to express their opinions and views.

The assumptions made above show that the respondents have a tendency to spend more time on either their handheld device or Internet when given the opportunity. This leads to productivity loss and can explain some of the reasons for the existence of the productivity paradox within information technology. In the section to follow a comparison between two groups will be done.

3.4.4. Compare the means of two groups

The reader should note that within the comparison of groups, the "Not Applicable" option for question 18 and question 19 was dropped in order to allow for the calculation of mean values.

- **Male versus female**

Comparison with question B.18.9 (the frequency of use of a handheld device in order to conduct personal business) was made. Within this comparison the difference between male and female in conducting personal business with their handheld device were compared.

Table 3-4: Male versus female comparison with handheld device

Question	***Grouping***	***N***	***Mean***	***Std Dev***	***p-value***		***Effect Size***
					Independent T-test	***Mann-Whitney***	
B.18.9	Male	78	2.24	1.119	0.020	0.019	**0.591**
	Female	21	2.90	1.091			

The effect size as shown in Table 3-4, indicates that there is a practically visible significance between males and females in conducting personal business with their handheld devices. It shows that females are more likely to use their handheld device in order to conduct personal business.

A comparison with question B.19.10 (the frequency to use social networking in order to follow or interact with an organisation's social or extracurricular activities) was also made. This comparison looked at the difference between males and females in using social networking to follow or interact with an organisation's social or extracurricular activities.

Table 3-5: Male versus female comparison with the use social networking

Question	***Grouping***	***N***	***Mean***	***Std Dev***	***p-value***		***Effect Size***
					Independent T-test	***Mann-Whitney***	
B.19.10	Male	46	2.50	1.090	0.015	0.017	**0.703**
	Female	15	1.73	0.961			

The effect size as shown in Table 3-5, indicates that there is almost a practical significance between males and females in using their social networking account in order to follow or interact with their organisation's social or extracurricular activities. It shows that males are more likely to follow or interact with their organisation's social or extracurricular activities.

- **Management versus Employee (Non management)**

A comparison with question B.18.9 (the frequency of use of a handheld device in order to conduct personal business) was made. The difference between management and employees in conducting personal business with their handheld device were invisaged.

Table 3-6: Management versus employee comparison with handheld device

Question	*Grouping*	*N*	*Mean*	*Std Dev*	*p-value*		*Effect Size*
					Independent T-test	*Mann-Whitney*	
B.18.9	Employee	43	2.72	1.120	0.010	0.010	**0.532**
	Management	56	2.13	1.096			

The effect size in Table 3-6, shows that there is a practically visible significance between management and employees (non management) in using their handheld devices in order to conduct personal business. It shows that employees are more likely to use their handheld device in order to conduct personal business.

- **People with Internet at work, with social network account versus People with Internet both at work and at home, with social network account**

The questions used in this comparison, were asked very vaguely in order to get a honest response from the respondents. This is one of the major problems with the study, that is the sensitivity of the subject at hand, namely the productivity of respondents during work hours.

In order to do the comparison between people with Internet access at work and people with Internet both at work and home, the data had to be grouped by two questions, which then were compared to a third question. The group was formed with question A.4 (whether the respondent has a social networking account) and question 15.3 (whether the respondent has access to the Internet at work or at home or both at work and home). For this grouping the researcher only looked at respondents with a social networking account and then split the group into two: respondents that use the Internet at work and respondents that use the Internet at home or both home and work.

The group discussed above compared with question C.21.6 (the time spent on social networking).

Table 3-7: Internet users compared with the time spent on social networking

Question	Grouping	N	Mean	Std Dev	p-value		Effect Size
					Independent T-test	Mann-Whitney	
C.21.6	People with Internet at work only, with social network account	10	3.600	1.713	.025	.019	**.730**
	People with Internet both at work and at home, with social network account	45	2.042	2.134			

Table 3-7 above indicates the effect size for the comparison made. The effect size shows that there are almost a practical significance between people with Internet at work only with social networking account, and people with Internet both at work and at home with social networking account. This means that people with Internet at work only, spends more time on their social networking account, than the other group which is people with Internet both at work and at home.

The assumptions made above shows that between males and females can be distinguished, as well as management and employees (non management) in the use of different information technologies. The comparisons made for the two groups mentioned do not have a large impact on the information technology productivity paradox. The last comparison made between Internet users, has a great impact on the information technology productivity paradox: the more time spent on social networking by the respondents that only make use of Internet at work can lead to productivity loss.

3.5. CONCLUSION

This study is intended to show whether the information technology productivity paradox exists within the heavy metal engineering industry in South Africa. This has an effect on the competitive advantage of organisations, in order to effectively compete. Therefore, it is very important to know whether this phenomenon exists within an organisation.

This chapter has shown that this phenomenon does exist, but it cannot be generalised due to the limited responses. Between the literature study and the empirical study, not all factors that were mentioned within the literature study could be proven with this chapter.

Two of the major factors that were covered within this chapter were the social networking aspect, and the aspect of human capital. With this chapter the researcher wanted to measure the impact of these aspects on the information technology productivity paradox.

CHAPTER 4: CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

4.1. INTRODUCTION

Throughout chapter two the focus was on the literature study about the information technology productivity paradox and the factors that contribute to it. This chapter will discuss the differences between the literature study and the empirical study. Even though not all the factors were focused on in the empirical study, the factors that were focused on will be highlighted and discussed in this chapter.

In this chapter the conclusion regarding the literature study and the results of the empirical research will be made. Shortcomings of the research will be discussed and recommendations for future research will be provided.

4.2. LIMITATIONS

In an empirical study, the researcher will have to rely on the honesty of the participants. This, however, may prove to be problematic as not many people would not be comfortable divulging details on their habits during working hours, especially the details as to whether they are productive or not. Another minor setback to this study is that there is very little material available on this topic.

4.3. CONCLUSION

The research done in chapter three, determined that the study population was represented by a majority of males, and that the majority of the respondents fell within the age categories of 21 - 40 years, making up 69% of the sample size used in the study. The sample size from the empirical study included respondents at 52.7% that used information technology in the role or capacity of management. It was also shown that 96.9% of the respondents had handheld devices that were setup to use the Internet, e-mail services, and / or social networking services. The correlations and comparisons made in the empirical study are discussed in the sections to follow.

4.3.1. Training and the use of systems

The development of human capital was shown as one of the factors that contribute to the information technology productivity paradox. It was shown that the time spent on the training of employees led to productivity loss. This however was not completely discarded with the empirical study.

In the empirical study it was shown that with the frequency of use of different computer systems, the level of skill for the respondents increased. This however does not discard the productivity loss due to the training of employees, but shows that with the time spent on systems the users of the system will start to increase productivity due to the level of skill acquired.

4.3.2. Use of and time spent on handheld devices

Even though handheld devices were not highlighted as one of the factors that contribute to the information technology productivity paradox, the empirical study showed a tendency for the respondents to spend more time on their handheld devices. Some of the tendencies that the respondents showed was to access their social networking account on their mobile device.

This was, however, not limited to work hours, so it cannot be seen as a factor that might lead to productivity loss.

4.3.3. Use of Internet access

The literature study did not highlight Internet access or use of it as a factor of the information technology productivity paradox. Through the empirical study it was shown that the respondents sometimes have shared Internet access, meaning that there are a number of people that share a computer in order to do their work. Logically this sharing of resources could lead to productivity loss on its own, but was not the topic of research within the empirical study.

The empirical study showed that the respondents sharing Internet access have a tendency to spend more time on their personal e-mail accounts than the respondents that have exclusive use of the Internet. This then logically leads to productivity loss due to the fact that not only are the respondents busy with personal e-mails, but they are also holding up the shared computer in order to do so.

4.3.4. Social networking from work

With the literature study social networking was pointed out to be one of the major factors in the productivity paradox. Within the literature study the social networking aspect was tested in order to see if these factors were also a major contributor in the heavy metal engineering industry.

With the empirical study many of the questions in the questionnaire had to be asked vaguely due to the sensitive nature of the study. Some of these questions were combined in order to group certain respondents together to see the impact on social networking. These questions included whether the respondents had a social networking account, whether the respondents have access to the Internet, and the time spent on a social networking account.

It can be argued that these are not conclusive results due to the vagueness of the questions, but the way in which they were grouped showed some interpretable results. The respondents were grouped as follows, group one was formed if the respondents have a social network account, and they only have access to the Internet at work; group two was formed if the respondents have a social networking account, and they have access to the Internet both at home and at work. These groups were then compared to the time spent on social networking, which was not limited to working hours as the researcher wanted to get a honest response.

After the comparison was done it was deduced that respondents who only had Internet access at work, showed a tendency to spend more time on their social networking accounts, which is then proof that social networking within the heavy metal engineering industry does contribute to the information technology productivity paradox.

4.4. RECOMMENDATIONS

With the empirical study done, it was shown that the information technology productivity paradox does exist in the heavy metal engineering industry of South Africa. The section above shows all the different aspects that were either proven or needs further investigation.

Some of the major setbacks of this study is the time involved in gathering the information, which allowed the researcher only to take into account a sample of the population. Due to this fact the recommendation made in this study are not meant to generalise, and are based on the observations made throughout the literature and empirical study.

In recent years the concept of competitive advantage has taken centre stage in discussions of business strategy. For this reason it is important to define competitive advantage in regards with an organisation: Competitive advantage can be defined as an advantage gained over competitors by offering customers greater value, either through lower prices or by providing additional benefits and services that justify similar, or possibly higher prices (Ehmke, 2008:1).

The literature study showed that with the existence of the productivity paradox, the competitive advantage is lost, due to the loss in productivity which is the ability to render an output from an input that is lost. Most of the factors mentioned within the empirical study about the time spent using information technology and not the actual use of information technology.

This then leads one to reason that the productivity paradox does not exist because of the wrong system being used, but the time spent on other systems due to the "increase" of productivity.

Therefore, it is recommended that organisations spend time analysing their information technology policies, and implement stricter regulations in regard to the use of destructive technologies, such as e-mail and social networking to name but a few.

4.5. SUGGESTIONS FOR FURTHER RESEARCH

Through the empirical study it was shown that the use of handheld devices may lead to productivity loss. It is therefore recommended that further research is done specifically on the use of handheld devices and the impact it has on the productivity paradox.

Furthermore, it was also shown that the Internet use also might have an impact on the productivity paradox, and further research on this aspect might also serve to be useful.

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APPENDIX A: QUESTIONNAIRE

THE IMPACT OF THE INFORMATION TECHNOLOGY PRODUCTIVITY PARADOX IN THE HEAVY METAL ENGINEERING INDUSTRY

Technology forms an integral part of the individual's life, whether it be professional or personal. Throughout the last few years, we, as a global society, have witnessed the birth and rapid expansion of technology and information technology in general. The purpose of this questionnaire is to get an understanding of the impact of information technologies in the heavy metal engineering industry as part of my MBA studies.

Your participation is voluntary and you may withdraw yourself from the study at any time, without fear of retribution.

After completion please return the questionnaire to rventer@dcd.co.za before 07/10/2011. The names of respondents will be kept confidential. All information collected will not be used anywhere else other than for the study.

For any questions or queries please contact me, Renier Venter at 082 657 0059 or 016 428 0047, or Johan Coetzee at 018 299 1382. Respondents may also contact me, Renier Venter, if they would like to get feedback on the results of the study.

Regards,

Renier Venter

Instructions

This questionnaire aims to measure the impact that information technology has on the productivity in the heavy metal engineering industry. Please answer the questionnaire by making a cross (**X**) in the space provided next to each item. In most of the questions you need only select ONE of the items, unless specifically stated otherwise.

Examples:

1. Would you like to full in a questionnaire?

1 X	Yes
0	No

2. What is your skill level for the following?

	Not Skilled	Not very Skilled	Very Skilled	Expert
Completing questionnaires	0	1	2	3 X

Here's how we define the devices or terminology mentioned in the questions below:

- A desktop computer is one that was not designed to be portable; the keyboard and monitor are usually separate units.
- A full-sized laptop computer is one that is designed to be portable; it usually weighs more than one kilogram; the keyboard and monitor are usually attached to each other.
- A lightweight netbook computer is highly portable; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard is small and built in.
- A tablet computer is highly portable; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard may be small and built in or the keys may be displayed in video on a touch screen. iPad is included here.
- A dedicated e-book reader is a portable device with the sole function of being a platform for reading electronic books and certain other electronic publications. Examples include Kindle, NOOK, and the like; iPad and similar tablet devices have many other functions and are therefore not included here.
- A handheld device is usually about the size of a cellular telephone and often includes one; it has a screen that can display e-mail messages, web pages, video, etc.; and its keyboard is at most a few centimetres wide, or the keys may be displayed in video on a touch screen. Included in this group are Personal Digital Assistants (PDA), Cellular phones, and Smart Phones.
- A social network is a web application that allows one to share media like photo's, music and videos. It also enables one to communicate with people all over the world.

Section A: Biographical details

1. What gender are you?

1	Male
2	Female

2. How old are you?__________________________

3. Highest level of education?

1	No Matric
2	Matric
3	No tertiary qualifications
4	Associated Diploma
5	Bachelor's Degree
6	Honour's Degree
7	Master's Degree
8	Doctor's Degree

4. Do you have a social networking account (Facebook, Twitter, MySpace, etc.)?

1	Yes
0	No

5. Do you have games installed on your computer at work?

1	Yes
0	No

6. Have you played the games installed on your work computer, during spare / lunch / tea times?

1	Almost Never	2	Sometimes	3	Often	4	Almost all the time

7. Do you play online games on your work computer, during spare / lunch / tea times?

1	Almost Never	2	Sometimes	3	Often	4	Almost all the time

8. Do you have a personal e-mail account (not a work e-mail account)?

1	Yes
0	No

9. Is your personal or work cellular phone setup to use e-mail, sms, or social networking?

1	Yes
0	No

Section B:What kind of information technology devices do you own / use?

10. How often do you work with information technology devices?

	Not Applicable	Almost Never	Sometimes	Often	Almost all the time
10.1 Desktop computer	0	1	2	3	4
10.2 Laptop computer	0	1	2	3	4
10.3 Lightweight netbook	0	1	2	3	4
10.4 Tablet computer	0	1	2	3	4
10.5 Dedicated e-book reader	0	1	2	3	4
10.6 Internet capable handheld device	0	1	2	3	4

11. How often do you use information technology devices at work?

1	Almost Never	2	Sometimes	3	Often	4	Almost all the time

12. Which of these best describe your preference: I do my work using... (Choose only one)

No information technology.	1
Limited information technology.	2
Moderate level of information technology.	3
Information technology extensively.	4
Information technology exclusively.	5

13. Which of the following best describes you? (Choose only one)

I am sceptical of new information technologies and use them only when I have to.	1
I am usually one of the last people I know to use new technologies.	2
I usually use new technologies when most people I know do.	3

I like new technologies and use them before most people I know.	4
I love new technologies and am among the first to experiment with and use them.	5

14. In which capacity or role do you utilise technologies? (Select all that apply).

14.1 As an employee	1
14.2 As management within an organisation	2
14.3 For personal use	3
14.4 For studies	4

15. Where do you most often

	I do not use it	At work	At home	Both at work and home
15.1 Use information technology device(s)?	0	1	2	3
15.2 Have access to information technology device(s)?	0	1	2	3
15.3 Access the Internet?	0	1	2	3

16. At work, do you

	Almost Never	Sometimes	Often	Almost all the time
16.1 Have exclusive use of information technology devices?	0	1	2	3
16.2 Share information technology devices with others?	0	1	2	3
16.3 Have exclusive use of Internet?	0	1	2	3
16.4 Share Internet with others?	0	1	2	3

17. Which of the following functions do you use in order to do your work?

	Almost Never	Sometimes	Often	Almost all the time
17.1 Spreadsheets (Excel, Numbers, Google Spreadsheets, etc.)	0	1	2	3
17.2 Presentation software (PowerPoint, Keynote, Google Presentations, etc.)	0	1	2	3
17.3 Graphics software (Photoshop, Flash, etc.)	0	1	2	3
17.4 Using the Internet to search for information (Google, Yahoo, Bing, etc.)	0	1	2	3
17.5 Enterprise resource planning (production planning, stock	0	1	2	3

control, finances, etc.)				
17.6 Software development	0	1	2	3

18. If you have a handheld device capable of the below features, which of these activities do you do from your handheld device?

	Not Applicable	Almost Never	Sometimes	Often	Almost all the time
18.1 Place and/or receive telephone calls	0	1	2	3	4
18.2 Text message	0	1	2	3	4
18.3 Instant message	0	1	2	3	4
18.4 E-Mail	0	1	2	3	4
18.5 Use social networking websites(Facebook, MySpace, etc)	0	1	2	3	4
18.6 Check information (news, weather, sports, specific facts, etc)	0	1	2	3	4
18.7 Read or contribute to blogs	0	1	2	3	4
18.8 Use maps (find places, get directions, or plan routes)	0	1	2	3	4
18.9 Conduct personal business (banking, shopping, etc.)	0	1	2	3	4
18.10 Use Internet photo sites	0	1	2	3	4
18.11 Watch mobile TV	0	1	2	3	4
18.12 Download/stream online media music	0	1	2	3	4

19. If you do have a social networking account, how often do you use social networking websites for?

	Not Applicable	Almost Never	Sometimes	Often	Almost all the time
19.1 Staying in touch with family and friends	0	1	2	3	4
19.2 Making new friends I have never met in person	0	1	2	3	4
19.3 Finding out more about people (I may or may not have met).	0	1	2	3	4
19.4 A form to express my opinions and views	0	1	2	3	4
19.5 Sharing photos, music, videos, or other work	0	1	2	3	4
19.6 Professional activities (job networking, etc.)	0	1	2	3	4
19.7 Participating in special-interest groups	0	1	2	3	4
19.8 Planning or invite people to events	0	1	2	3	4

19.9 Playing games	0	1	2	3	4
19.10 Following/interacting with my organisations social/extracurricular activities	0	1	2	3	4
19.11 Communicating with colleagues about work topics	0	1	2	3	4

20. How often do you contribute to the following for work purposes?

	Almost Never	Sometimes	Often	Almost all the time
20.1 Wiki's (Wikipedia)	0	1	2	3
20.2 Blog's	0	1	2	3
20.3 Video-sharing websites (Youtube)	0	1	2	3

Section C: looks at the impact of technologies on you within your business and/or private life. Keep in mind that these technologies include cellular phone usage.

21. Approximately how much time is spent daily on your

21.1. handheld device? ____________________________

21.2. personal e-mails? ____________________________

21.3. business e-mails? ____________________________

21.4. personal calls? ____________________________

21.5. business calls? ____________________________

21.6. social networking account? ____________________________

21.7. online games? ____________________________

22. To what extent do you agree/disagree with the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
22.1 Your organisation places importance on the use of information technology	1	2	3	4
22.2 Your organisation places importance on the use of information technology as an enabler of productivity	1	2	3	4
22.3 Productivity = Sales per Employees	1	2	3	4
22.4 Productivity = Jobs Completed proportionate to Jobs Scheduled	1	2	3	4
22.5 Productivity = Output as proportion of Labour Cost	1	2	3	4
22.6 Productivity = Output per Hours worked	1	2	3	4
22.7 Technology has enabled you to get tasks done more efficiently	1	2	3	4

23. **In comparison with previously, when information technology was not available yet, information technology allows you to complete your tasks faster?**

1	Strongly Agree	2	Agree	3	Disagree	4	Strongly Disagree

24. **In the case that information technology has reduced the amount of hours spent on daily tasks by how many hours have it been reduced?**

____

25. **Information technology reduced the number of hours I worked?**

1	Almost Never	2	Sometimes	3	Often	4	Almost all the time

26. **What usually happens with the spare time from tasks completed faster? (Choose only one)**

Get wasted	1
Workload gets increased	2
More attention is given to other tasks	3
There is no time to spare	4

27. **Overall, what is your opinion about the productivity of workers at your organisation?**

1	Very Poor	2	Poor	3	Good	4	Excellent

<u>Section D: Your perceived skill level and opinions about information technology?</u>

28. **What is your skill level for the following?**

	Not Skilled	**Somewhat Skilled**	**Skilled**	**Expert**
28.1 Spreadsheets (Excel, Numbers, Google Spreadsheets, etc.)	0	1	2	3
28.2 Presentation software (PowerPoint, Keynote, Google Presentations, etc.)	0	1	2	3
28.3 Graphics software (Photoshop, Flash, etc.)	0	1	2	3
28.4 Using the Internet to effectively and efficiently search for information	0	1	2	3
28.5 Enterprise resource planning (production planning, stock control, finances, etc.)	0	1	2	3
28.6 Software development	0	1	2	3

29. **What drives your investment, if any, in information technology? Why will you buy technology?**

	Strongly Agree	Agree	Disagree	Strongly Disagree
29.1 Increased familiarity of technologies. The technologies are becoming easier to understand and use.	1	2	3	4
29.2 Increased importance of technology for your business strategy. Required to survive in business.	1	2	3	4
29.3 Increased need for a more responsive workforce in the market.	1	2	3	4
29.4 Advancement in technologies increased device capabilities. More usable features.	1	2	3	4
29.5 The technology increases efficiency	1	2	3	4
29.6 The technology increases productivity	1	2	3	4
29.7 The technology increases cost efficiency.	1	2	3	4
29.8 The technology Increases service and product quality.	1	2	3	4

30. **In regards with your productivity and efficiency, did it improve in terms of the following statements?**

	Strongly Agree	Agree	Disagree	Strongly Disagree
30.1 Availability of staff. Can reach them anywhere anytime. Increased availability.	1	2	3	4
30.2 Information being available to more people more frequently. Increased accessibility.	1	2	3	4
30.3 Availability of applications such as calendar, contacts, e-mail, etc.	1	2	3	4
30.4 Location (bound to office walls) and time restrictions (working	1	2	3	4

	Strongly Agree	Agree	Disagree	Strongly Disagree
hours) are limited or something of the past. Not limited to the office space or work hours.				
30.5 Availability of business applications to sales people to do e.g. quotes and orders at the customer's site.	1	2	3	4
30.6 Field service personnel have information available in real time thus improving service delivery.	1	2	3	4
30.7 Improved customer experience i.e. improved responsiveness through e-mail and/or cell phones.	1	2	3	4

31. In regards with product or service quality, did it improve in terms of the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
31.1 Product and service information is more readily accessible i.e. price; features; location of shipment; to your customers.	1	2	3	4
31.2 Availability of your services such as balance enquiries, money transfers, online support, etc. increased through the use of Wireless and Mobile technologies.	1	2	3	4
31.3 Service delivery improved through the direct access anywhere anytime to your business systems E.g. Intranet, Internet, billing systems, BAAN, etc.	1	2	3	4

32. How did the technology impact your life *negatively?*

	Strongly Agree	Agree	Disagree	Strongly Disagree
32.1 Increased working hours due to accessibility of information, tasks and applications from home or any other location outside the office.	1	2	3	4

32.2 Spending less time with your family and or friends. Fewer social interaction.	1	2	3	4
32.3 Workload increased due to your increased availability outside office hours and walls.	1	2	3	4

Thank you for your assistance in completing this questionnaire. It is much appreciated.

Please remember to forward me your feedback as soon as possible.

Regards,

Renier Venter

APPENDIX B: RESPONSE SUMMARY TABLE

1	Almost Never	2	Sometimes	3	Often	4	Almost all the time

Question	Description	Valid %				# Mis	Mean	Std Dev
		1	2	3	4			
6	**Have you played the games installed on your work copmuter, during spare / lunch / tea times?**	63.6	17.8	10.1	8.5	0	1.636	0.976
7	**Do you play online games on your work computer, during spare / lunch /tea times?**	93.8	6.2	0	0	0	1.062	0.242
10	**How often do you work with information tehcnology devices**							
10.1	Desktop computer	21.7	12.4	19.4	27.9	0	2.657	1.208
10.2	Laptop computer	17.1	19.4	14.7	34.1	0	2.773	1.178
10.3	Lightweight netbook	18.6	13.2	10.9	19.4	0	2.500	1.222
10.4	Tablet computer	15.5	6.2	1.6	0.0	0	1.400	0.621
10.5	Dedicated e-book reader	1.6	0.8	0.0	0.8	0	2.000	1.414
10.6	Internet capable handheld device	0.8	7.8	27.9	55.0	0	3.500	0.689
11	**How often do you use information technology devices at work?**	0	0.8	11.6	87.6	0	3.868	0.362
16	**At work, do you**							
16.1	Have exclusive use of information technology devices?	27.1	21.7	13.2	38.0	0	1.620	1.245
16.2	Share information technology devices with others?	25.6	17.1	27.1	30.2	0	1.620	1.167
16.3	Have exclusive use of Internet?	21.7	25.6	16.3	36.4	0	1.674	1.180
16.4	Share Internet with others?	37.2	18.6	17.1	27.1	0	1.341	1.234
17	**Which of the following functions do you use in order to do your work?**							
17.1	Spreadsheets (Excel, Numbers, Google Spreadsheets, etc.)	0.8	24.0	35.7	39.5	0	2.140	0.808
17.2	Presentation software (PowerPoint, Keynote, Google, Presentations, etc.)	7.8	35.7	29.5	27.1	0	1.760	0.942
17.3	Graphics software (Photoshop, Flash, etc.)	55.0	41.1	2.3	1.6	0	0.504	0.627
17.4	Using the Internet to search for information (Google, Yahoo, Bing, etc.)	3.9	36.4	37.2	22.5	0	1.783	0.838
17.5	Enterprise resource planning (production planning, stock control, finances, etc.)	7.8	31.0	24.8	36.4	0	1.899	0.991
17.6	Software development	51.9	41.1	3.1	3.9	0	0.589	0.735
18	**If you have a handheld device capable of the below features, which of these activities do you do from your handheld device?**							
18.1	Place and/or receive telephone calls	4.7	1.6	34.1	56.6	0	3.472	0.758
18.2	Text message	1.6	3.9	49.6	44.2	0	3.375	0.640
18.3	Instant message	3.1	5.4	42.6	44.2	0	3.341	0.734
18.4	E-Mail	1.6	3.9	35.7	56.6	0	3.508	0.654

18.5	Use social networking websites	21.7	24.8	18.6	14.7	0	2.330	1.070
18.6	Check information	16.3	24.0	21.7	19.4	0	2.543	1.065
18.7	Read or contribute to blogs	24.0	14.0	16.3	14.7	0	2.315	1.164
18.8	Use maps	17.1	27.9	15.5	18.6	0	2.451	1.077
18.9	Conduct personal business	23.3	17.8	18.6	17.1	0	2.384	1.140
18.10	Use Internet photo sites	27.1	16.3	14.0	14.0	0	2.207	1.153
18.11	Watch mobile TV	20.9	14.7	19.4	14.7	0	2.400	1.130
18.12	Download/stream online music	17.1	20.2	10.1	21.7	0	2.528	1.178
19	**If you do have a social networking account, how often do you use social networking websites for?**							
19.1	Staying in touch with family and friends	7.0	14.0	17.1	14.0	0	2.731	1.009
19.2	Making new friends I have never met in person	15.5	11.6	12.4	7.0	0	2.233	1.079
19.3	Finding out more about people (I may or may not have met).	14.7	14.0	8.5	10.1	0	2.295	1.131
19.4	A form to express my opinions and views	17.8	14.7	10.9	5.4	0	2.079	1.021
19.5	Sharing photos, music, videos, or other work	14.7	20.2	7.8	7.8	0	2.169	1.024
19.6	Professional activities (job networking, etc.)	19.4	11.6	7.0	8.5	0	2.100	1.145
19.7	Participating in special-interest groups	13.2	13.2	7.8	10.9	0	2.362	1.150
19.8	Planning or invite people to events	19.4	10.1	7.8	10.1	0	2.180	1.190
19.9	Playing games	16.3	14.0	9.3	7.0	0	2.150	1.071
19.10	Following/interacting with my organisations social/extracurricular activities	14.0	14.0	10.1	9.3	0	2.311	1.104
19.11	Communicating with collegues about work topics	15.5	10.9	13.2	7.0	0	2.250	1.083
20	**How often do you contribute to the following for work purposes?**							
20.1	Wiki's (Wikipedia)	97.7	1.6	0.8	0	0	0.031	0.214
20.2	Blog's	99.2	0.8	0	0	0	0.008	0.088
20.3	Video-sharing websites (Youtube)	97.7	2.3	0	0	0	0.023	0.151
25	**Information technology reduced the number of hours I worked?**	20.2	21.7	35.7	22.5	0	2.605	1.049

1	Strongly Agree	2	Agree	3	Disagree	4	Strongly Disagree

Question	Description	Valid %				# Mis	Mean	Std Dev
		1	2	3	4			
22	**To what extent do you agree/disagree with the following?**							
22.1	Your organisation places importance on the use of information technology	46.5	51.2	2.3	0.0	0	1.558	0.544
22.2	Your organisation places importance on the use of information technology as an enabler of productivity	40.3	58.9	0.8	0.0	0	1.605	0.506
22.3	Productivity = Sales per Employees	34.1	58.1	6.2	1.6	0	1.752	0.638
22.4	Productivity = Jobs Completed proportionate to Jobs Scheduled	50.4	47.3	1.6	0.8	0	1.527	0.574

22.5	Productivity = Output as proportion of Labour Cost	44.2	51.2	4.7	0.0	0	1.605	0.579
22.6	Productivity = Output per Hours worked	43.4	55.0	1.6	0.0	0	1.581	0.526
22.7	Technology has enabled you to get tasks done more efficiently	50.4	48.8	0.8	0.0	0	1.512	0.547
23	**In comparison with previously, when information technology was not available yet, information technology allows you to complete your tasks faster?**	48.1	50.4	2	0	0	1.535	0.531
29	**What drives your investment, if any, in information technology? Why will you buy technology?**							
29.1	Increased familiarity of technologies. The technologies are becoming easier to understand and use.	41.1	55.0	3.9	0.0	0	1.628	0.560
29.2	Increased importance of technology for your business strategy. Required to survive in business.	47.3	52.7	0.0	0.0	0	1.527	0.501
29.3	Increased need for a more responsive workforce in the market.	41.1	58.1	0.8	0.0	0	1.597	0.508
29.4	Advancement in technologies increased device capabilities. More usable features.	41.9	57.4	0.8	0.0	0	1.589	0.509
29.5	The technology increases efficiency	48.1	50.4	1.6	0.0	0	1.535	0.531
29.6	The technology increases productivity	41.9	56.6	1.6	0.0	0	1.597	0.523
29.7	The technology increases cost efficiency.	55.0	44.2	0.8	0.0	0	1.457	0.516
29.8	The technology increases service and product quality	40.3	59.7	0.0	0.0	0	1.597	0.492
30	**In regards with your productivity and efficiency, did it improve in terms of the following statements?**							
30.1	Availability of staff. Can reach them anywhere anytime. Increased availability.	45.0	54.3	0.8	0.0	0	1.558	0.514
30.2	Information being available to more people more frequently. Increased accessibility.	43.4	55.8	0.8	0.0	0	1.574	0.512
30.3	Availability of applications such as calendar, contacts, e-mail, etc.	49.6	50.4	0.0	0.0	0	1.504	0.502
30.4	Location (bound to office walls) and time restrictions (working hours) are limited or something of the past. Not limited to the office space or work hours.	41.9	56.6	1.6	0.0	0	1.597	0.523
30.5	Availability of business applications to sales people to do e.g. quotes and orders at the customer's site.	45.7	52.7	1.6	0.0	0	1.558	0.529
30.6	Field service personnel have information available in real time thus improving service delivery.	50.4	48.8	0.8	0.0	0	1.504	0.517
30.7	Improved customer experience i.e. improved responsiveness through e-mail and/or cell phones.	50.4	49.6	0.0	0.0	0	1.496	0.502

31	**In regards with product or service quality, did it improve in terms of the following statements?**							
31.1	Product and service information is more readily accessible i.e. price; features; location of shipment; to your customers.	42.6	55.0	2.3	0.0	0	1.597	0.538
31.2	Availability of your services such as balance enquiries, money transfers, online support, etc. increased through the use of Wireless and Mobile technologies.	50.4	48.8	0.8	0.0	0	1.504	0.517
31.3	Service delivery improved through the direct access anywhere anytime to your business systems E.g. Intranet, Internet, billing systems, BAAN, etc.	52.7	45.7	1.6	0.0	0	1.488	0.532
32	**How did the technology impact your life *negatively?***							
32.1	Increased working hours due to accessibility of information, tasks and applications from home or any other location outside the office.	35.7	52.7	9.3	2.3	0	1.783	0.707
32.2	Spending less time with your family and or friends. Fewer social interaction.	36.4	50.4	9.3	3.9	0	1.806	0.761
32.3	Workload increased due to your increased availability outside office hours and walls.	37.2	51.9	7.8	3.1	0	1.767	0.724

1	Very Poor	2	Poor	3	Good	4	Excellent

Question	Description	Valid %				# Mis	Mean	Std Dev
		1	2	3	4			
27	**Overall, what is your opinion about the productivity of workers at your organisation?**	22.5	27.1	35.7	14.7	0	2.426	0.998

1	Not Skilled	2	Somewhat Skilled	3	Skilled	4	Expert

Question	Description	Valid %				# Mis	Mean	Std Dev
		1	2	3	4			
28	**What is your skill level for the following?**							
28.1	Spreadsheets (Excel, Numbers, Google Spreadsheets, etc.)	30.2	20.9	31.0	17.8	0	1.364	1.096
28.2	Presentation software (PowerPoint, Keynote, Google, Presentations, etc.)	25.6	35.7	24.8	14.0	0	1.271	0.998
28.3	Graphics software (Photoshop, Flash, etc.)	49.6	45.0	5.4	0	0	0.558	0.598
28.4	Using the Internet to search for information (Google, Yahoo, Bing, etc.)	28.7	27.9	31.0	12.4	0	1.271	1.014
28.5	Enterprise resource planning (production planning, stock control, finances, etc.)	28.7	31.0	24.0	16.3	0	1.279	1.053
28.6	Software development	52.7	43.4	1.6	2.3	0	0.535	0.650

APPENDIX C: COMPARISON SUMMARY TABLE

Male versus Female

Question	Grouping	N	Mean	Std Dev	p-value		Effect Size
					Independent T-test	Mann-Whitney	
B.18.1	Male	97	3.41	0.760	0.097	0.026	0.350
	Female	28	3.68	0.723			
B.18.2	Male	100	3.40	0.603	0.469	0.599	0.150
	Female	28	3.29	0.763			
B.18.3	Male	97	3.35	0.630	0.844	0.384	0.041
	Female	26	3.31	1.050			
B.18.4	Male	100	3.57	0.555	0.121	0.180	0.327
	Female	26	3.27	0.919			
B.18.5	Male	80	2.29	1.081	0.447	0.436	0.176
	Female	23	2.48	1.039			
B.18.6	Male	83	2.54	1.004	0.991	0.984	0.003
	Female	22	2.55	1.299			
B.18.7	Male	72	2.33	1.113	0.789	0.700	0.070
	Female	17	2.24	1.393			
B.18.8	Male	82	2.41	1.077	0.501	0.473	0.169
	Female	20	2.60	1.095			
B.18.9	Male	78	2.24	1.119	0.020	0.019	0.591
	Female	21	2.90	1.091			
B.18.10	Male	75	2.29	1.160	0.121	0.124	0.405
	Female	17	1.82	1.074			
B.18.11	Male	74	2.43	1.099	0.605	0.548	0.141
	Female	16	2.25	1.291			
B.18.12	Male	70	2.46	1.200	0.256	0.252	0.277
	Female	19	2.79	1.084			

Question	Grouping	N	Mean	Std Dev	p-value		Effect Size
					Independent T-test	Mann-Whitney	
B.19.1	Male	48	2.63	1.044	0.145	0.183	0.359
	Female	19	3.00	0.882			
B.19.2	Male	46	2.35	1.100	0.116	0.141	0.446
	Female	14	1.86	0.949			
B.19.3	Male	46	2.39	1.125	0.256	0.221	0.345
	Female	15	2.00	1.134			
B.19.4	Male	46	2.02	1.064	0.434	0.351	0.201
	Female	17	2.24	0.903			

B.19.5	Male	46	2.17	1.018	0.956	0.921	0.015
	Female	19	2.16	1.068			
B.19.6	Male	45	2.16	1.167	0.511	0.535	0.190
	Female	15	1.93	1.100			
B.19.7	Male	44	2.36	1.163	0.986	1.000	0.006
	Female	14	2.36	1.151			
B.19.8	Male	45	2.24	1.190	0.492	0.449	0.202
	Female	16	2.00	1.211			
B.19.9	Male	45	2.20	1.057	0.553	0.471	0.176
	Female	15	2.00	1.134			
B.19.10	Male	46	2.50	1.090	0.015	0.017	0.703
	Female	15	1.73	0.961			
B.19.11	Male	46	2.35	1.079	0.214	0.194	0.388
	Female	14	1.93	1.072			

Employee versus Management

Question	***Grouping***	***N***	***Mean***	***Std Dev***	***p-value***		***Effect Size***
					Independent T-test	***Mann-Whitney***	
B.18.1	Employee	60	3.52	0.770	0.529	0.337	0.112
	Management	65	3.43	0.749			
B.18.2	Employee	61	3.49	0.674	0.050	0.015	0.331
	Management	67	3.27	0.592			
B.18.3	Employee	58	3.36	0.788	0.772	0.505	0.049
	Management	65	3.32	0.687			
B.18.4	Employee	60	3.40	0.741	0.082	0.130	0.278
	Management	66	3.61	0.551			
B.18.5	Employee	48	2.48	1.031	0.186	0.168	0.255
	Management	55	2.20	1.095			
B.18.6	Employee	50	2.48	1.147	0.570	0.541	0.105
	Management	55	2.60	0.993			
B.18.7	Employee	46	2.48	1.188	0.171	0.178	0.285
	Management	43	2.14	1.125			
B.18.8	Employee	47	2.36	1.131	0.445	0.383	0.146
	Management	55	2.53	1.034			
B.18.9	Employee	43	2.72	1.120	0.010	0.010	0.532
	Management	56	2.13	1.096			
B.18.10	Employee	43	2.16	1.153	0.735	0.692	0.071
	Management	49	2.24	1.164			
B.18.11	Employee	40	2.28	1.109	0.349	0.351	0.196
	Management	50	2.50	1.147			
B.18.12	Employee	44	2.39	1.104	0.264	0.304	0.225
	Management	45	2.67	1.243			

Personal versus Non-Personal

Question	*Grouping*	*N*	*Mean*	*Std Dev*	*p-value*		*Effect Size*
					Independent T-test	*Mann-Whitney*	
B.19.1	Personal use	42	2.69	1.000	0.674	0.666	0.105
	Non personal	25	2.80	1.041			
B.19.2	Personal use	37	2.16	1.041	0.532	0.543	0.161
	Non personal	23	2.35	1.152			
B.19.3	Personal use	38	2.08	1.124	0.052	0.044	0.510
	Non personal	23	2.65	1.071			
B.19.4	Personal use	40	2.13	0.992	0.653	0.565	0.115
	Non personal	23	2.00	1.087			
B.19.5	Personal use	41	2.27	0.975	0.329	0.203	0.243
	Non personal	24	2.00	1.103			
B.19.6	Personal use	37	1.95	1.153	0.186	0.126	0.348
	Non personal	23	2.35	1.112			
B.19.7	Personal use	35	2.23	1.140	0.282	0.284	0.290
	Non personal	23	2.57	1.161			
B.19.8	Personal use	37	2.03	1.142	0.225	0.221	0.312
	Non personal	24	2.42	1.248			
B.19.9	Personal use	37	2.05	1.053	0.390	0.379	0.226
	Non personal	23	2.30	1.105			
B.19.10	Personal use	37	2.05	1.053	0.024	0.023	0.604
	Non personal	24	2.71	1.083			
B.19.11	Personal use	36	2.11	1.008	0.243	0.252	0.295
	Non personal	24	2.46	1.179			

Respondents with only Internet access at work, with social network account versus Respondents with Internet access at both work and home, with social network account

Question	*Grouping*	*N*	*Mean*	*Std Dev*	*p-value*		*Effect Size*
					Independent T-test	*Mann-Whitney*	
C.21.6	People with only Internet at work, with social network account	10	3.600	1.713	.025	.019	.730
	People with Internet both at work and at home, with social network account	45	2.042	2.134			

APPENDIX D: CORRELATION SUMMARY TABLES

Question Comparison		Correlation	Significance	Sample size
A.2	B.10.5	-0.389	0.611	4
A.7	B.19.6	0.309	0.016	60
	C.21.7	0.745	0.000	129
B.10.1	B.10.5	0.500	0.667	3
B.10.4	B.10.5	1.000	0.000	3
B.10.5	B.10.6	0.500	0.667	3
B.11	B.10.5	0.544	0.456	4
B.12	B.10.5	0.500	0.500	4
	B.13	0.900	0.000	129
B.13	B.10.5	0.500	0.500	4
	B.19.10	-0.307	0.016	61
	D.28.3	0.301	0.001	129
B.16.1	B.10.2	0.842	0.000	110
	B.16.2	-0.556	0.000	129
	B.18.6	-0.328	0.001	105
B.16.2	B.10.2	-0.529	0.000	110
	B.18.6	0.320	0.001	105
B.16.3	B.10.2	0.308	0.001	110
	B.10.4	0.301	0.106	30
	B.10.6	0.472	0.000	118
	B.16.4	-0.650	0.000	129
B.16.4	B.10.2	-0.318	0.001	110
	B.10.4	-0.307	0.099	30
	C.21.2	0.342	0.000	129
B.17.1	D.28.1	0.760	0.000	129
B.17.2	B.10.5	-0.949	0.051	4
	C.22.3	-0.325	0.000	129
	D.28.2	0.624	0.000	129
B.17.3	B.10.5	-0.389	0.611	4
B.17.4	B.10.4	0.402	0.028	30
	B.10.5	-0.544	0.456	4
	D.28.4	0.569	0.000	129
B.17.5	B.10.4	-0.385	0.036	30
	B.10.5	-0.833	0.167	4
	D.28.5	0.746	0.000	129
B.17.6	B.10.5	-0.544	0.456	4
B.18.10	B.18.12	0.410	0.000	70
B.18.11	B.19.11	0.347	0.019	45
	B.19.3	0.322	0.029	46
B.18.12	B.19.3	0.310	0.036	46
	B.19.5	0.325	0.028	46
	B.19.9	0.344	0.020	45
B.18.2	B.10.5	0.500	0.667	3
	B.18.3	0.352	0.000	123
B.18.3	B.10.4	-0.317	0.101	28
	B.10.5	0.500	0.667	3
	B.18.7	0.304	0.004	89
	B.19.5	0.354	0.005	62

Question Comparison		Correlation	Significance	Sample size
	B.19.9	0.347	0.008	58
B.18.4	B.10.5	0.500	0.667	3
	B.18.11	0.300	0.004	90
	B.19.5	0.319	0.011	63
B.18.5	B.10.5	1.000	0.000	2
	B.18.8	0.310	0.004	85
B.18.6	B.10.5	0.500	0.667	3
	B.19.5	0.305	0.031	50
B.18.7	B.10.5	0.500	0.667	3
	B.19.10	0.373	0.009	48
	B.19.9	0.301	0.038	48
B.18.8	B.10.5	0.500	0.667	3
B.18.9	B.10.4	0.302	0.134	26
	B.10.5	-0.500	0.667	3
B.19.11	B.10.6	0.307	0.019	58
B.19.2	B.10.4	-0.359	0.309	10
	B.19.10	0.342	0.008	59
	B.19.3	0.409	0.001	60
B.19.3	B.10.2	-0.358	0.008	54
	B.10.4	-0.353	0.317	10
	B.10.5	1.000	0.000	2
	B.19.10	0.424	0.001	59
	B.19.7	0.324	0.013	58
B.19.4	B.10.5	1.000	0.000	2
	B.19.10	0.384	0.003	59
B.19.5	B.10.5	1.000	0.000	2
B.19.6	B.10.4	0.534	0.112	10
B.19.7	B.19.10	0.333	0.011	58
B.19.8	B.10.5	1.000	0.000	2
B.19.9	B.10.4	0.571	0.085	10
	B.19.10	0.311	0.017	59
B.20.1	B.20.2	0.582	0.000	129
	B.20.3	0.661	0.000	129
B.20.2	B.20.3	0.573	0.000	129
C.21.1	B.18.2	0.307	0.000	128
	B.18.7	0.316	0.003	89
	B.19.10	0.408	0.001	61
	B.19.3	0.337	0.008	61
	B.19.4	0.303	0.016	63
	B.19.6	0.310	0.016	60
	C.21.2	0.388	0.000	129
	C.21.4	0.522	0.000	129
	C.21.5	0.301	0.001	129
	D.32.3	-0.326	0.000	129
C.21.2	B.10.5	0.889	0.111	4
	B.18.10	0.366	0.000	92
	B.19.11	0.349	0.006	60
	B.19.2	0.379	0.003	60
	B.19.7	0.357	0.006	58
	C.21.4	0.563	0.000	129
	C.21.5	0.396	0.000	129

Question Comparison		Correlation	Significance	Sample size
	D.29.4	-0.322	0.000	129
	D.32.1	-0.410	0.000	129
	D.32.2	-0.432	0.000	129
	D.32.3	-0.335	0.000	129
C.21.3	B.10.5	0.389	0.611	4
	C.21.5	0.460	0.000	129
C.21.4	B.10.4	-0.350	0.058	30
	B.10.5	-0.389	0.611	4
	B.18.10	0.391	0.000	92
	B.19.10	0.554	0.000	61
	B.19.3	0.333	0.009	61
	B.19.6	0.388	0.002	60
	B.19.7	0.376	0.004	58
	C.21.5	0.462	0.000	129
	C.26.1	0.320	0.000	129
	C.26.3	-0.324	0.000	129
	D.28.1	-0.376	0.000	129
	D.28.4	-0.369	0.000	129
	D.32.1	-0.382	0.000	129
	D.32.3	-0.361	0.000	129
C.21.5	B.18.10	0.330	0.001	92
	B.18.7	0.323	0.002	89
	B.19.10	0.334	0.009	61
	B.19.2	0.304	0.018	60
	B.19.3	0.324	0.011	61
	B.19.8	0.337	0.008	61
	C.22.3	-0.326	0.000	129
	D.29.1	-0.337	0.000	129
	D.32.1	-0.399	0.000	129
C.21.6	B.19.10	0.324	0.011	61
	B.19.6	0.363	0.004	60
C.22.1	B.10.5	0.544	0.456	4
	B.19.6	-0.334	0.009	60
	C.22.4	0.341	0.000	129
	C.25	-0.342	0.000	129
C.22.2	B.19.7	-0.394	0.002	58
C.22.3	B.19.2	-0.342	0.008	60
	C.22.5	0.344	0.000	129
	D.32.1	0.322	0.000	129
C.22.4	B.10.5	-0.500	0.500	4
C.22.5	B.10.4	0.332	0.073	30
C.22.7	B.10.5	-0.816	0.184	4
	B.18.5	-0.346	0.000	103
C.23	B.10.5	-0.889	0.111	4
C.26.1	C.26.2	-0.310	0.000	129
	C.26.3	-0.412	0.000	129
	D.32.3	-0.338	0.000	129
C.26.2	B.19.5	-0.354	0.004	65
	B.19.9	-0.352	0.006	60
	C.26.3	-0.364	0.000	129
C.26.3	B.10.5	0.544	0.456	4

Question Comparison		Correlation	Significance	Sample size
	C.26.4	-0.350	0.000	129
C.26.4	B.10.5	-0.544	0.456	4
D.28.1	B.19.10	-0.362	0.004	61
D.28.2	B.10.5	-0.943	0.057	4
	D.28.5	0.338	0.000	129
D.28.4	B.10.4	0.380	0.038	30
	B.10.5	-0.816	0.184	4
	B.18.7	-0.376	0.000	89
D.28.5	B.10.5	-1.000	0.000	4
	B.18.11	-0.313	0.003	90
D.28.6	B.10.5	-0.544	0.456	4
D.29.1	B.19.3	-0.363	0.004	61
	B.19.7	-0.403	0.002	58
	D.29.4	0.309	0.000	129
D.29.3	D.32.2	0.329	0.000	129
D.29.4	B.10.2	0.346	0.000	110
	B.19.7	-0.314	0.016	58
D.29.5	B.10.5	0.544	0.456	4
D.29.8	B.10.5	0.544	0.456	4
	B.19.11	-0.317	0.014	60
D.30.1	B.10.5	0.544	0.456	4
D.30.4	B.10.5	-0.544	0.456	4
	B.19.7	-0.351	0.007	58
D.30.7	B.19.6	0.355	0.005	60
D.31.1	B.10.4	-0.323	0.082	30
D.32.1	B.10.5	-0.333	0.667	4
	B.18.10	-0.531	0.000	92
	B.19.2	-0.301	0.019	60
	D.32.2	0.563	0.000	129
	D.32.3	0.340	0.000	129
D.32.2	B.10.5	-0.500	0.500	4
	B.19.2	-0.322	0.012	60
	D.32.3	0.336	0.000	129
D.32.3	B.18.7	-0.324	0.002	89
	B.19.10	-0.302	0.018	61
	B.19.2	-0.343	0.007	60
	B.19.3	-0.332	0.009	61
	B.19.6	-0.347	0.007	60