Information Quality Training Requirements Analysis Guideline Demonstrated in a Healthcare Context

(A Design Science Approach)

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A dissertation presented in Fulfilment of the

Requirements for PhD

Dublin City University
January 2011

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Date: January 2011

Publication List

Peer Reviewed Journals

Levis Mary, Malcolm Brady, Markus Helfert (2008), 'Total Quality Management Underpins Information Quality Management' *The Journal of American Academy of Business, Cambridge* (JAABC). Vol. 14, No.1, pp 172-178.

Levis Mary, Malcolm Brady, Markus Helfert (2008), 'Website Design Quality and Form Input Validation: An Empirical Study on Irish Corporate Websites' *Journal of Service Science and Management* (JSSM). Vol. 1, No.1, pp 87-96.

Conferences

Levis, Mary, Malcolm Brady, Markus Helfert (2008), 'Form Input Validation on Irish Corporate Websites' *10th International Conference on Enterprise Information Systems (ICEIS)* 12th -16th, June 2008, Barcelona, Spain.

Levis, Mary, Malcolm Brady, Markus Helfert (2008), 'Identifying Information Quality Problems in a healthcare scenario' *International Association for Development of the Information Society (IADIS) - International Conference Information Systems* 9th - 11th April, 2008, Algarve, Portugal.

Levis, Mary, Malcolm Brady, Markus Helfert (2008), 'Information Quality Issues Highlighted by Deming's Fourteen Points on Quality Management' *International Conference on Business Innovation and Information Technology (ICBIIT)* 24th January 2008, Dublin City University, Ireland.

Levis, Mary, Malcolm Brady, Markus Helfert (2008), 'IQ Management: Review of an Evolving Research Area' *12th International Conference on Information Quality (ICIQ)* 09th - 11th November 2007, Cambridge, Massachusetts, USA.

Levis Mary, Malcolm Brady, Markus Helfert (2007), Applying Information Quality Concepts in a practical Healthcare setting *12th annual conference of the UK Academy for Information Systems (UKAIS) 11th– 12th April 2007, Manchester, UK.*

Dedication

This dissertation is dedicated primarily in gratitude to my mother, Betty, who has always believed in me and to my late father, Benjamin, for altering the course of my life, which eventually led me to the world of academia. It is dedicated also to my immediate and extended family in gratitude for their ongoing encouragement through this process. Finally and especially dedicated (to my partner) Josef van Genabith for his unconditional love, unfailing support and encouragement through my doctoral journey and for encouraging me to follow my dream to achieve this Ph.D.

Acknowledgments

This dissertation could not have been completed without the support and backing of many individuals. First, I would like to record my gratitude to my supervisors, Dr Malcolm Brady, (Dublin City University, Business School) and Dr Markus Helfert, (Dublin City University, School of Computing). I remain forever grateful for the advice, encouragement and support they both gave me in various ways from the onset of my academic career as well as giving me extraordinary experiences through out the work.

In addition, special thanks to Professor David Jacobson, whose familiarity with the support needs of all Ph.D scholarship students provided a constant oasis of helpful ideas and inspired and enriched my growth as a Ph.D student. I am deeply indebted to him.

Particular thanks to Dublin City University Business School, for their sponsorship through scholarship funding, without, which my Ph.D could not have been undertaken. I would like to include all staff of Dublin City University, Business School, for offering such a wide and varied range of help and guidance during my research.

I gratefully acknowledge Pamela Henry, Mary Kirwan and Mary Mc Grath, Dublin City University, School of Nursing, for the involvement of their students and the use of their virtual hospital, to carry out my experiment. Sincere thanks to all the students who freely gave of their valuable time to participate in the experiment.

A special gratitude goes to my dear friend, Muireann Ni Dhuigneain and my cousin Frances Carey, who encouraged me to endure the journey throughout the trials and hardships of dealing with my illness, Multiple Sclerosis and for

setting my sights on the honour of being called 'Dr. Mary. This acknowledgement would be incomplete without also mentioning my family and friends whose' dedication, love and persistent confidence in me, has taken a load off my shoulders. Many thanks also goes to Fred Murphy for his support throughout my undergraduate degree that underpinned this Ph.D.

Words fail me to express my appreciation to my partner Josef, to whom I owe a special debt of gratitude for his loyalty, support and persistent confidence in me that inspired me during my journey.

Collective and individual acknowledgments are also due to my work colleagues in the Business School, and especially to my colleagues in the Business Informatics Group, School of Computing, I was extraordinarily fortunate in having their continual support and encouragement in my pursuit of this degree.

Special acknowledgment must go to Dr John Murphy, who freely offered to assist me in my thesis writing and expertly guided my style. I am forever grateful to him for his patience and advice. A special note of thanks also goes to Lisa Carey, Brigit O Neill, Josie Donovan and Richard Ryan, and Ita Tobin for their help with the data gathering process. Finally, I would like to thank everybody who was important to the successful realization of this thesis, as well as expressing my sincere apology that I could not mention you all personally one by one. To one and all, I humbly say, *'Thank you!'*

List of Abbreviations

A&E	Accident and Emergency
AIMQ	Assessment of Information Management Quality
ASQ	American Society for Quality
BS	Behavioural Science
CIS	Clinical Indemnity Scheme
DQ	Data Quality
DS	Design Science
EFQM	European Foundation for Quality Management
EU	European Union
FFM	Five Factor Model
IOM	Institute of Medicine
IQ	Information quality
IQA	Information Quality Assessment
IQAM	Information Quality Assessment Methodology
IQM	Information Quality Management
IQTPs	Information Quality Training Plans
IQTRA	Information Quality Training Requirements Analysis
IQTRAG	Information Quality Training Requirements Analysis Guideline
IP	Information Product
IS	Information System
ISMP	Institute of Safe Medication Practices
ISO	International Standards Organization
IT	Information technology
KM	Knowledge Management
KS	Kolmogorov-Smirnov (Test)
Non EU	Non European Union

OECD	Organisation for Economic Co-operation and Development
RAS	Results Assessment System
RSCI	Royal College of Surgeons Ireland
SCA	State Claims Agency
SPC	Statistical Process Control
SPSS	Statistical Package for Social Science
SQ	System Quality
US	United States
QM	Quality Management
TDQM	Total Data Quality Management
TQM	Total Quality Management

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Abstract

In recent years, organizations have realized the critical importance of Information Quality Management (IQM) as a means to achieve long-term business success. Yet, many organizations find it difficult to implement an effective Information Quality Training Plan (IQTP). One reason for this is that they fail to identify the prime predictors of Information Quality (IQ) and therefore, the resources and likewise the commitment to develop an effective, systematically tailored approach to IQTPs is lost.

To systematically address this problem is the primary driver behind this thesis. To achieve this objective, a practical conceptual model, which allows the measurement of the anticipated predictors' impact on IQ, and a Design Science (DS) problem-based solution; an Information Quality Training Requirements Analysis Guideline (IQTRAG) is proposed. This model was validated by means of a controlled laboratory experiment, a Web based survey and interviews and discussions with practitioners and experimental participants.

Data was gathered through triangulation, evaluated through a combination of t-tests and correlation and regression analysis. The findings show that relationships exist between IQ and 1) trainee characteristics, 2) training design, 3) work environment, 4) trainee' perception of IQ importance, and 5) trainee work and documentation experience. The results from the analysis supported the hypotheses and the need for an Information Quality Training Requirements Analysis Guideline to aid the development of Information Quality Training Plans. Based on this analysis it can be recommended that organizations use the Information Quality Training Requirements Analysis Guideline before implementing Information Quality Training Plans.

Chapter 1

INTRODUCTION

1.1. Introduction and Background to Study

Many adverse events and medical errors have been found to be based on poor information quality (IQ) practices. This study investigates the information quality of healthcare documentation based on three dimensions of information quality: accuracy, completeness and consistency. The purpose of the research is to identify the key attributes of high quality healthcare information and to examine the relationship between training of healthcare providers and information quality.

Shared information about medication regimens have been identified as concerns (Nadkarni 2006). An acceptable healthcare record is a prerequisite for efficient treatment of patients and has a noticeable impact on the quality of medical care. Even though we live in the information technology (IT) age, patient care records continue to be mainly paper-based. Handwritten documentation tends to be incomplete and thus may be unreliable. Causes of medical errors include but are not limited to: poor communication among caregivers; inadequate staffing; transcription errors that lead to poor IQ and adverse drug effects.

Attention to medical errors escalated with the release of a significant review concerning safety and quality of healthcare in the United States (US) in two Institute of Medicine (IOM) reports: 'To Err Is Human' (IOM 2001) when they

reported that between 44,000 and 98,000 Americans die each year in hospitals due to preventable medical errors (IOM 1999, IOM 2001; Berwick 2002; Sadler Blair 2006). Errors involving prescription medications are responsible for up to 7,000 American deaths annually and the financial costs of drug-related morbidity and mortality may reach $77 billion a year (Institute for Safe Medication Practices (ISMP)).

A report from the President's Advisory Commission on Consumer Protection and Quality in the Health Care Industry released in 1998 identified medical errors as a major challenge in improving healthcare quality (AHRQ 1998). This is further highlighted given that more than one in five Americans (22 percent) report that they or a family member have experienced a medical error of some kind (The Commonwealth Fund 2002). Based on the IOM's lower estimate of 44,000 deaths annually, medical errors rank as the eighth leading cause of death in the US -- higher than motor vehicle accidents (43,458), breast cancer (42,297), or AIDS (16,516) as of 1999 (AHRQ 2000; Jacobs et al. 2007).

In 2006 the IOM issued a follow up study in which they estimated that between 380,000 and 450,000 hospital drug errors occur annually and concluded that there were at least 1.5 million preventable medication errors yearly (IOM 2006). Since the release of the IOM studies, there has been a greater focus on the quality of healthcare provided in the US, and an awakening of the healthcare sector to the challenge of reducing the number of adverse events in hospitals by inciting a redesign of the healthcare system (Gendon & D'Onofrio 2001).

The IOM define medical errors and adverse events as follows:

> *"Medical Error: the failure to complete a planned action as intended or the use of a wrong plan to achieve an aim."*

"Adverse Event: an injury caused by medical management rather than by the underlying disease or condition of the patient."

Adverse events occur in 2.9 to 3.7 percent of hospital admissions (IOM 2001; Berwick 2002). In the US these preventable patient injuries resulting from medical mistakes cost the economy an extra $17 to $29 billion in annual healthcare costs (IOM 1999; Connecting for Health Common Framework 2006). However, some adverse events are not preventable as they reflect the risk often associated with treatment, such as a life-threatening allergic reaction to a drug when the patient had no known allergy to it. The patient who receives an antibiotic to which he or she is known to be allergic and dies, represents a preventable adverse event (AHRQ 2006). Many of these adverse events are due to poor IQ among caregivers.

A study conducted in 2008 by a team from the School of Pharmacy, Royal College of Surgeons Ireland (RCSI) focused on the documentation involved in the transfer of cardiology patients from an Irish training hospital. It found that 10.8 percent of medication prescriptions at discharge featured inconsistencies, which affected 65.5 percent of patients. The most common inconsistency was drug omission which accounted for 20.9 percent of the discrepancies (School of Pharmacy RCSI 2008). This can be identified as a 'completeness of information' problem, one of the many IQ dimensions discussed further in Chapter 2. It was also revealed that medication errors at the time of hospital admission are associated with one in five injuries or deaths and it was estimated that 46 percent of medication errors occur when patient prescriptions are written (School of Pharmacy RCSI 2008).

Another study carried out at Toronto General Hospital in 2006 consisting of 150 patients showed that 41.3 percent had at least one medication discrepancy at hospital discharge. The most common discrepancies were incomplete prescriptions requiring clarification (49.5 percent) and omitting medications

(22.9 percent). Of the discrepancies, 29.5 percent had the potential to cause possible or probable patient discomfort and/or clinical deterioration (Toronto General Hospital 2006). Here again the problem of 'completeness of information' is obvious.

The Department of Pharmacy, Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada, undertook studies of patients reporting regular prescription medication errors. All discrepancies were rated for their potential to cause patient harm and at least one discrepancy appeared in 53.6 percent of the cases studied. The most common error (46.4 percent) was the omission of a regularly used medication and 38.6 percent of these discrepancies had the potential to cause moderate to severe discomfort or clinical deterioration (Department of Pharmacy, Sunnybrook, Toronto, Ontario, Canada 2010). This study further enforces 'completeness' as being a major area for concern.

The Faculty of Medicine University of Ottawa, undertook a systematic review of studies describing the frequency, type, and clinical importance of medication history errors at hospital admission. Errors in prescription medication histories occurred in up to 67 percent of cases and over a quarter of hospital prescribing errors are attributable to incomplete medication histories at the time of admission (Faculty of Medicine University of Ottawa). This is another example of completeness problems within healthcare documentation.

The quality of medical prescription in the Department of Community Medicine, University of Ribat, Khartoum (University of Ribat, Khartoum 2010), detected errors in doctors' prescriptions by randomly selecting one thousand medical prescriptions and checking them for completeness and legibility. The patient's full name was written on 18.8 percent of prescriptions, and that of the doctor 6.7 percent. In only 19.5 percent were drugs prescribed by their generic

names, 59.7 percent lacked the quantity of the drug, 25.7 percent lacked the duration of treatment and 15.8 percent were difficult to read (University of Ribat, Khartoum 2010). Another study presented findings from a small pilot study conducted to identify medication documentation problems at the point of hospital discharge among older adults. A review of 104 medical records revealed several problems in documenting patient medication including legibility, use of medical abbreviations and incomplete and missing entries. Patients reported taking more drugs than were listed in the medical record (University of Ribat, Khartoum 2010). Yet again, completeness is posed as being among the most common occurring problems within documentation followed by 'consistency of information'. From these studies the problem most often highlighted is lack of completeness. A table of studies on medical errors is given in Appendix A.

In Ireland too, medical errors are often highlighted in the media because they are considered to be extraordinary cases. Healy (2010) reports on a 62 year old woman who was awarded 90,000 euro in High Court damages after a surgical wire was left in her body during an operation. O' Regan (2007) reported 'one in 10 patients is a victim of hospital blunders'; Donnellan (2007) declared that '60 percent of Accident and Emergency (A&E) patients had errors in their prescriptions'; Keogh (2006) reported an incident where a 'mother died after the ambulance went to the wrong address'; Donnellan (2010) reports where an inquiry told of a kidney removal error on an 8-year-old boy at Our Lady's Hospital for Sick Children in 2008, and in yet another case Donnellan and Smyth (2010) reports that a woman was wrongly told she had miscarried her baby when in fact she was still pregnant.

Hospitals in Ireland have reported nearly 300,000 incidents involving mistakes or near misses in the last five-and-a-half years resulting in €133m in compensation payouts. Of the overall number, 3,522 incidents had gone on to

result in compensation claims (http://www.hospitalmanagement.net/press/). Moreover, according to the Clinical Indemnity Scheme (CIS), which provides state insurance for hospitals and other health agencies, there were 55,058 events in 2007. A total of 431 claims were submitted to it arising from adverse incidents (www. irishhealth.com 2009). The following year witnessed a rise of more than 50 percent, bringing the number to 83,661 reported adverse incidents. During the same period, medication errors rose from 5,436 to 6,785 cases. According to information gathered by the State Claims Agency (SCA), almost 84,000 clinical errors or adverse events affecting patients were recorded in Irish hospitals in 2008. Although the majority related to slips and falls, thousands involved more serious medication and treatment errors, These include: (8,250) medication incidents such as incorrect doses or the wrong medicine administered to patients; treatment incidents, which included incorrectly leaving surgical swabs or devices in patients' bodies following operations (5,559) and incorrect records or documented events (5,650), which led to 'near misses' or, in rare cases, catastrophic incidents (O'Brien 2010). The average cost of an award was €63,000. Patient safety and the reduction of medication errors have now become widespread topics of discussion.

There are estimates quoted in various international studies of between 4 and 11 percent of total hospital admissions that highlight medical accidents as being a leading cause of premature death. A study of 30,000 hospital records in New York, Brennan et al. (1991), found that injuries from care occur in 3.7 percent of hospital admissions and 13.6 percent of these led to death. There are in excess of 4 million patient cases admitted to or treated by Irish hospitals per annum and making the assumption that 4 percent are injured due to medical accidents, this would equate to 160,000 patients injured per annum in Ireland in hospitals due to medical accidents (Boylan 2010).

Even though the actual figure is unknown (because no studies have been carried out), this number is consistent with the most recent figures from the SCA. Based on international figures, as many as 8,000 patients may die each year in Ireland as a result of preventable clinical errors (O'Brien 2010). According to Boylan (2010), claims submitted through the CIS show that the highest number of claims by specialty was surgery with 119 claims up to December 2009, followed by Medicine 110; Obstetrics 102; Emergency Medicine 62; and Gynaecology 24. In addition, figures obtained by the Medical Independent (Kelly 2010) show that in the period of 1 July 2009 to 31 December 2009 the HSE paid €14.851 million to the SCA to deal with medical litigation settlements.

In Ireland more than €60 million was paid out in 2009 to patients who suffered from serious medical errors in the health service. This figure is €13m lower than the total paid out by the State in total for the previous five years between 2003 and 2008, and according to SCA this sum was provided as compensation for thousands of medical claims taken by patients (O Cionnaith 2009), see table 1-1.

Table 1-1 Prominent Medical Litigation Settlements 2008/2009

PROMINENT MEDICAL LITIGATION SETTLEMENTS 2008/2009		
Myers v St James's Hospital	Brain injury as an alleged result of misdiagnosis	€6.5 million + legal costs
Leo Conroy v Rotunda Hospital	Severe hypoxia, cerebral palsy as a result of alleged undue delay in recognising foetal distress and delay in performing Caesarean section:	€5.25 million + legal costs
CB v CLIH	Severe spastic quadriplegic cerebral palsy resulting from alleged failure to respond to abnormal CTG trace:	€2 million + legal costs
MK v CNOH	Negligent perforation of elderly plaintiff's bowel during routine hip replacement:	€80,000 + legal costs
AD v CLIH	Death of infant boy, physical/psychological injury to parent, resulting from alleged negligent management of labour:	€115,000 + legal costs
DK v CLIH & NG	Permanent injury to brachial plexus, resulting from alleged excessive amounts of oxytocin and excessive force/traction during labour	€190,000 + legal costs
SM v HSE & MM	End-stage renal failure, resulting from alleged negligence by GP and hospital in failing to diagnose and act upon impending renal failure	€350,000 + legal costs
IH & DH v HSE & KH	Death of infant girl, physical/psychological injury to parents, resulting from alleged sub-standard care by obstetrician and midwifery staff	€80,000 + legal costs
SM v RR	Brachial plexus injury causing disability, resulting from alleged negligence	€800,000
SK v RH	Alleged hospital negligence resulting in perineal trauma during labour	€270,000 + legal costs
CT & KT v HSE	Emotional/psychiatric damage to parents alleged from labour complications	€100,000
MMCD v MH	Scrotal orchiectomy due to alleged failure to manage post-operative infection	€125,000 + legal costs

One case involved the Rotunda Hospital, Dublin versus Leo Conroy who was born on the 20 March 2003 in very poor condition. He suffered severe injury to his brain leading to cerebral palsy. The case made on his behalf was that in the hours prior to his birth the monitor, which was recording his heart rate, indicated that he was suffering from ever increasing and severe fetal distress, which was not acted upon by the attending midwives or doctors. Unfortunately the undue delay in recognising these signs led to an undue delay in performing an emergency Caesarean Section. The case was settled for a sum of €5,250,000 plus costs (Boylan 2010).

Another case in 2009, Myres v St James' Hospital (Boylan 2010) obtained €6.5 million to a catastrophically injured 50 year old woman with an undiagnosed subarachnoid hemorrhage. Myers attended St James' A&E Department and was wrongly discharged from hospital without the benefit of a CAT scan investigation. She collapsed at home 24 hours later and was taken by ambulance to Beaumont Hospital where she underwent emergency surgery to evacuate the large haematoma which had formed as a result of bleeding. Unfortunately although her life was saved by the neurosurgery performed at Beaumont, she was left with permanent brain damage and cognitive deficits as a consequence of the uncontrolled bleeding which had occurred following her discharge 24 hours previously from A&E in St James' Hospital.

The CB v CLIH case was that of a minor suffering from severe spastic quadriplegic Cerebral Palsy. Substandard care on the part of hospital and obstetric staff in failing to respond to an abnormal CTG trace (which monitors the baby's heart rate) and to signs that the unborn baby was in distress suggested that the hospital and staff were negligent in failing to expedite delivery of the baby which would have prevented the baby's severe brain injury. The case settled for a damages amount of €2 million plus legal costs.

MK v CNOH: involved the negligent perforation of the elderly womans' bowel during a routine hip replacement procedure in April of 2005. The woman was in her mid 80's at the time of surgery. Her solicitor alleged negligence on the part of the Hospital as there were numerous delays. The case settled for damages of €80,000 plus costs.

AD v CLIH: a pregnant lady had a significantly increased risk of uterine rupture during labour that required a caesarean section. The Hospital gave her increasing amounts of syntocinon (a synthetic equivalent of the body's own hormone, oxytocin, which is used to induce labour and increases

strength and frequency of contractions). This caused unduly frequent uterine contractions which are known to cause foetal distress and to put more stress on the uterus itself. Ultimately the Plaintiff's uterus ruptured and her baby son was deprived of oxygen resulting in catastrophic brain injuries from which he died a day later. The damages offer was €115,000 plus costs.

DK v CLIH & NG: is a case involving a young boy. He was a large baby at the time of his birth and during the delivery a shoulder dystocia occurred. It was alleged that there was negligence on the part of the Hospital and the obstetrician in negligently using excessive amounts of oxytocin and that the obstetrician in charge of the labour used excessive force when pulling on the baby's head in an effort to release the trapped shoulder. As a result the baby suffered a permanent injury to his brachial plexus (the network of nerves running from the spine, proceeding through the neck, through the armpit region and in to the arm). Damage to this network of nerves caused permanent disability and significantly limited his use of his left arm and hand for everyday tasks such as dressing. The settlement for damages was €190,000 plus legal costs.

SM v HSE & MM: the plaintiff in this case was a young man in his late teens who attended the hospital in the late 2000 and due to the failure of the hospital to carry out appropriate tests, his impending renal failure was not diagnosed. A few months later, the plaintiff attended his GP at which time blood tests were carried out. Despite the fact that his blood results were abnormal and indicated a renal problem, these results were not acted upon. As a result, the plaintiff later collapsed with end-stage renal failure, lost consciousness and suffered from seizures. He suffered a number of cerebral haemorrhages, which caused permanent cognitive deficits. He required dialysis three times a week and had to undergo a renal transplant many years

earlier than he otherwise would have done. The case settled for a damages amount of €350,000 pus legal costs.

In the case of IH & DH v HSE & KH: the plaintiffs were a married couple. As the wife had a complex obstetric and gynaecological history and had undergone a previous classical caesarean section there was a greater risk of uterine rupture in subsequent pregnancies. During her 37th week of pregnancy, the plaintiff contacted the Hospital complaining of pain and tenderness around the site of the previous classical caesarean section scar. She was admitted to the labour ward of the Hospital and suffered a uterine rupture, which caused the death of her baby daughter. A delay in expediting delivery of the baby once a decision had been made to deliver by emergency caesarean section resulted in the uterine rupture. The case settled on for the amount of €80,000 plus legal costs.

In the case of SM (a minor) v RR: the plaintiff's mother was admitted to Hospital under the defendant's care and the plaintiff claimed that by reason of the negligence of the defendant during labour and delivery, the plaintiff was caused to suffer a brachial plexus injury as a result of shoulder dystocia resulting in a permanent and significant disability. The case settled for the sum of €800,000.

In the SK v RH case it was alleged that failure to identify the extent of the perineal trauma suffered during delivery resulted in debilitating symptoms of incontinence. Expert opinion was received outlining the extensive reconstructive surgery the plaintiff would require in order to correct the defect in her anal sphincter muscle and to close the recto-vaginal fistula. It is established medical opinion that secondary repairs are far less satisfactory than primary repairs made immediately following delivery and carry a greater

chance of failure. The matter was settled for a sum of €270,000 plus legal costs.

CT & KT v HSE: CT underwent a traumatic delivery of her child in late March 2004. AT was born in very poor condition and required resuscitation and intubation and was taken to the Special Care Baby Unit. The plaintiffs held leading expert psychiatric evidence to show the severe mental trauma they suffered due to the defendant's negligence in the delivery of their son. The plaintiffs' case concluded after their child's cerebral palsy action in late 2008 for €100,000. The settlement was without an admission of obstetric fault causing psychiatric injuries to the plaintiffs.

MMCD v MH: in this case the plaintiff attended the hospital where he was diagnosed with a tense large hydrocele (a swelling of the scrotum caused by excessive fluid caused by inflammation or trauma). He underwent surgery some months later for drainage and plication of the hydrocele and was discharge two days later. Shortly after the plaintiff was discharged he complained of scrotal swelling, pain and a discharge from the surgical wound. His General Practitioner referred him to the hospital A&E Department. Here he was reviewed by the Urological Registrar who reassured him that there was no infection. He returned in 11 days for outpatient review by his Consultant Urologist who examined him and noted a major infection in his scrotum requiring admission for further investigation and intravenous antibiotics. The plaintiff later underwent the insertion of a testicular prosthesis. The allegations of negligence made on behalf of the plaintiff were; that there was a failure to provide adequate antibiotic cover in the immediate postoperative period when only 1 to 2 days of cover were provided following an operation that routinely requires 7 to 10 days of antibiotic cover; there was a failure to diagnose the post operative infection when the plaintiff was referred back to the surgical team by his General Practitioner when he first

complained of swelling, pain and a discharge; a failure to diagnose the extent of the infection when the plaintiff attended for the second time at the defendant Hospital and a failure to prescribed adequate antibiotic treatment as was required at that stage. It was also unfortunately the case that the plaintiff's testis could have been saved had the extent of the infection been appreciated on either of his earlier attendances at the hospital. The matter settled for a damages sum of €125,000 plus legal costs.

Therefore, improving quality of healthcare and healthcare information is not just an academic exercise; it is of utmost importance to healthcare providers. One observable problem has been over-reliance on the quality of healthcare records. Complex care is typically uncoordinated, information is often not available to those who need it when it is needed, and as a result patients often do not get care they need.

1.2. Motivation for Conducting this Research

As the previous section outlined, many adverse events in healthcare can be attributed to IQ problems. Recent findings regarding the cost of medical errors highlight the importance of seeking ways to improve patient safety and reducing costs. As IQ problems are often associated with high costs, improving IQ is fast becoming a significant issue for healthcare providers, managers and government departments. In this section we highlight the importance of IQ and its effect in both the public and private sectors, which provided the motivation for conducting this research. Current evidence shows that poor IQ is pervasive and has a significant negative effect on healthcare and business success (Mathieu & Khalil 1998). Evidence in the literature supports the notion that poor healthcare information leads to substantial loss in human life, compromised quality of life and also economic losses (Redmond 1996; Eckerson 2002; Fisher et al. 2006). Quality improvement in healthcare today is

occurring at many levels, but is generally poorly coordinated. Further research is needed to elicit the theoretical underpinnings on which to understand the needs of healthcare in managing IQ.

Many of the IQ issues found in healthcare are also found in other industries. The impact of poor IQ on business performance is widely studied. A common perception is that good IQ improves decision quality and in turn business performance. One prime example is the eyewear company that failed to recognize that data errors were the root cause of their fifteen percent lens-grinding rework rate, costing the company at least $1 million yearly (Wang et al.1998). Another typical example is the healthcare organization that consistently overpaid $4 million in claims annually for patients who were no longer eligible for benefits (Katz-Haas & Lee 2005). It is further highlighted by the hospital staff who misplaced a decimal point, failed to notice the error, and then allowed a fatal overdose to be administered to a paediatric patient (Belkin 2004). Despite the pervasiveness of poor IQ, many users appear to be ineffective in detecting errors. More than 60 percent of surveyed firms had problems with IQ (Wand & Wang 1996). This suggests that information users are not always aware of the poor quality of information on which they rely.

In other industries, it is estimated that 1 percent to 10 percent of data in organisational databases is inaccurate (Klein et al. 1997; Klein 1998) and many organisations have experienced the adverse effects of decisions based on poor IQ (Huang et al. 1999). Redmond (1996) report that poor IQ costs the typical company from 10 percent to 20 percent of revenue. English (1996/2004) infers that wrong price data in retail databases may cost American consumers as much as $2.5 billion in overcharges yearly. Fisher et al. (2006) report that IQ problems cost US businesses more that $600 billion per year. Moreover, leadership and management depend on the quality of decisions (Redmond 1996), the quality of the data used to make them (Ballou & Tayi 1999) and the

quality of information service in general (Mathieu & Khalil 1998). As in all organizations, healthcare managers rely on data to direct and lead them and the complexity of healthcare needs an extensive range of decisions, both administrative and health-related. When doctors make decisions using poor IQ there is a greater risk that their conclusions may be wrong.

As the health sector is increasingly an information driven service, IQ is often linked to the use of the Information Systems (IS). Health information is made up of varying types of information that include administrative information needed to manage the complex business of healthcare, and clinical information based on patient related data found in patient records. This information describes the characteristics of the patient, their illness, and their healthcare plans. Healthcare professionals need to share and exchange information about the care of their patients. However handover between shifts which are aimed at preserving the flow of activities (Patterson & Woods 2001) have caused preventable adverse patient reactions (Perry 2004; Van Eaton et al. 2004). AHRQ (2006) explains how failed handovers contributed to a patient's death. Patient heart rates, blood pressure, temperature or drug administration may be recorded incorrectly and not sufficiently. Thus, IQ problems arise when there is incomplete, inaccurate and inconsistent information (Wand & Wang 1996). Information of high quality enables the healthcare team to respond to sudden changes in the patient's condition, (Hall et al. 2005).

Yet, until the IOM 1999 report, medical errors did not receive the attention or awareness of the significant financial burden that make an impact on the healthcare system. The IOM report estimates that medical errors cost the US roughly $37.6 billion each year and about $17 to 29 billion of these costs are associated with preventable errors (IOM 1999). The Centres for Medicare and Medicaid Services project that US spending on healthcare will rise to $2.82 trillion in 2011 and the cost of poor quality care will likely exceed $1 trillion. The

study found that 30 percent of direct healthcare spending was the result of poor quality care much of which is rooted in poor quality IQ (Charatan 2002). Outlay in healthcare has increased dramatically in the past ten years. In Ireland, according to the Irish Medical News (2006), there was a significant increase in health spending from 3 billion in 1995 to a gross current spending of €15 billion in 2009.

The Organisation for Economic Co-operation and Development (OECD) Health Data (2008), which compares health systems and government spending for 30 countries over the last decade, reports that the percentage of Ireland's GDP assigned to health is below the European average. It was found that total health spending accounted for 7.5 percent of Ireland's GDP in 2007. This is almost 1.5 percent lower than the 8.9 percent average for other OECD countries in Europe. Looking at the trend during this decade, the US spent the most on healthcare as a share of its economy, with 16 percent of its GDP assigned to health in 2007, followed by France at 11 percent and Switzerland at 10.8 percent. Several EU countries, Germany, Belgium and Austria also devoted more than 10 percent of their GDP to health in 2007. These figures suggest that healthcare issues are not solely due to lack of funding, but suggestive of other causes including poor IQ. Management decisions that designate tasks to improperly trained personnel make errors more likely, such as emergency room physicians or nurses not checking administered drugs or dosages. The financial downside to medical errors is a significant issue facing hospital executives.

Many authors have tried to optimize training through development of theoretical models and by examining the impact of training variables such as trainee characteristics, training design, and work environment factors on the transfer process (Baldwin & Ford 1988; Thayer & Teachout 1995; Holton 1996). This study considers that training is an important aspect in order to improve IQ and

thus healthcare. Due to the lack of detailed studies, the impact of training on IQ is relatively unknown. However, analysis from this study shows that training, trainee characteristics, work environment factors, perception of IQ, and work experience, are high predictors of IQ. The results suggest the need to design an Information Quality Training Requirements Analysis Guideline (IQTRAG) to support development of Information Quality Training Plans (IQTPs).

1.3. Research Proposition

This research aims to investigate the relationship between training and IQ. Therefore, the objective of this study is to present and test a model of the relationship between training design, trainee characteristics and the work environment and IQ. This study will also evaluate the potential impact of each of these predictors on IQ in three IQ dimensions: accuracy, completeness and consistency. The identification of types of error and classification into dimensions of IQ are helpful in their prevention and reduction.

The impact of these elements on IQ outcomes using subjective and objective measurement was investigated via a mixed method approach. Accuracy, completeness and consistency were used as the measure of IQ performance. By analysing the relationship between training and other predictors of IQ on IQ output, an Information Quality Training Requirements Analysis Guideline was developed as a problem based solution to improve IQ.

As a society we are part of many different social systems and dependant on information shared with others. Thousands of research reports have been produced on user information needs (Dervin & Nilan 1986; Wilson & Walsh 1996). Hospital professionals such as nurses and doctors contribute to recording information in patient charts, and problems occur when information is not recorded in a quality fashion. Inaccurate and incomplete information may

lead to severe operational outcomes that lead to life-and-death issues. As discussed above, poor healthcare documentation is a fundamental issue that needs to be addressed.

As the aim of this research is to analyse the relationship and impact of three important categories of predictors of IQ: training, the work environment and trainee characteristics the general research proposition is as follows: 'If systematic training is applied, information quality will increase in a way that will ultimately decrease medical errors in documentation'. This led to six sets of hypotheses.

The first of hypothesis focused on the effects of training on IQ (accuracy consistency and completeness measured by comparing the error logs for μ accuracy, μ consistency and μ completeness of information filled in manual filled patient records before and after training), so as to put in place a systematic processes that identify predictors of Information quality and to develop an Information Quality Training Requirements Analysis Guideline as means to improve IQ.

H1: 'If systematic training is applied training will be associated with improved IQ.

The general expectation that training will produce more accurate, consistent and complete information that led to three sub-hypotheses:

H1a: 'If systematic training is applied consistency will be associated with improved IQ.

H1b: 'If systematic training is applied accuracy will be associated with improved IQ.

H1c: ‘If systematic training is applied completeness will be associated with improved IQ.

Another aspect of good IQ outcomes is trainee characteristics. While medical incidences are instructive in highlighting the importance of IQ, it should be noted that not all errors are attributable to lack of training. Noticeable research in the training literature, Chapter 2, supports the relationship between personality traits and job performance (Barrick & Mount 1991; Costa & McCrae 1995; Colquitt & Simmering 1998; Barrick et al. 1998). Among those traits, conscientiousness (Costa & McCrae 1992) is considered to be especially promising in predicting training proficiency (Hogan & Ones 1997). Therefore, the second hypothesis is to examine the possible effect of the trainee characteristic (conscientiousness) on IQ (accuracy, consistency and completeness).

H2: Conscientiousness will be associated with improved IQ.

The expectation is that trainee characteristics will be a high predictor of IQ. In order to investigate how trainee characteristics have an impact on IQ, we investigate 4 further sub-hypotheses.

H2a: Self discipline will be associated with improved IQ.

H2b: Achievement striving will be associated with improved IQ.

H2c: Dutifulness will be associated with improved IQ.

H2d: Self-efficacy will be associated with improved IQ.

A third aspect worthy of investigation was training duration and sequencing. Martocchio & Judge (1997) noted a negative correlation between conscientiousness and learning on a study carried out after a short training

program, while Colquitt & Simmering (1998) reported a positive correlation between conscientiousness and learning when they adopted a longer training program. Consideration of time in training may account for discrepancies in findings between these two studies. Therefore, the third hypothesis examines the impact of training programs on IQ.

H3: 'If systematic training design is applied training design will be associated with improved IQ. The expectation is that training duration and sequencing will be predictors of IQ.

H3a: 'If systematic training design is applied training duration will be associated with improved IQ.

H3b: 'If systematic training design is applied training sequencing will be associated with improved IQ.

Many frameworks outline factors that may promote the transfer of skills after training. Kozlowski & Salas (1997) discuss the importance of characterizing the factors and processes by which training interventions are carried out in organizations. If significant progress is to be made in improving IQ then quality managers must develop an understanding of how and why training works or does not work. Such an understanding must bring together laws governing human characteristics with laws governing the environments in which they operate. Therefore, another influencing factor on IQ is the work environment which suggests the fourth hypothesis.

H4: Work environment will be associated with improved IQ. The expectation is that the work environment plays a role in predicting IQ.

H4a: IS (Information Systems both IT based (electronic) and paper based (manual)) will be associated with improved IQ.

H4b: Support factors will be associated with improved IQ.

H4c: Form layout will be associated with improved IQ.

Errors can be classified as skill-based, knowledge-based and other errors such as judgment based on experience. Therefore the fifth hypothesis is:

H5: Experience will be associated with improved IQ

H5a: Experience on documentation recording will be associated with improved IQ.

H5b: Work Experience will be associated with improved IQ.

According to (Olson 2003) accurate information is 'the most important dimension' of good quality IS, yet many IS contain errors and most organisations lack the basic understanding of the concepts of IQ. Therefore the sixth hypothesis is as follows:

H6. Perception of the importance of IQ will be associated with improved IQ.

1.4. Research Approach

This section outlines the research approach and highlights its significance and contribution to the knowledge base. To build a robust healthcare system, researchers need to understand factors that contribute to better IQ. It is noted from the literature review in Chapter 2, that there has been little theoretical, practical or empirical research on IQ predictors. As a result, this study was positioned to fill this gap. Therefore, a conceptual model to empirically explore IQ predictors was developed by adjusting the 'transfer of training' model designed by Baldwin & Ford (1988) to fill similar gaps in the training literature. The IQ predictor model consists of three primary lenses: Firstly, trainee

characteristics (self-discipline, self-efficacy, dutifulness and achievement striving under the construct of conscientiousness): secondly, training design (frequency, duration, perception of IQ importance and trainee experience), and thirdly, the work environment (peer support, information system, and form layout). The model also incorporates an IQ outcomes element assessed on three main IQ dimensions, namely accuracy, completeness and consistency. Elements investigated within this study are represented by the ✓ symbol within this model (see figure 1-1).

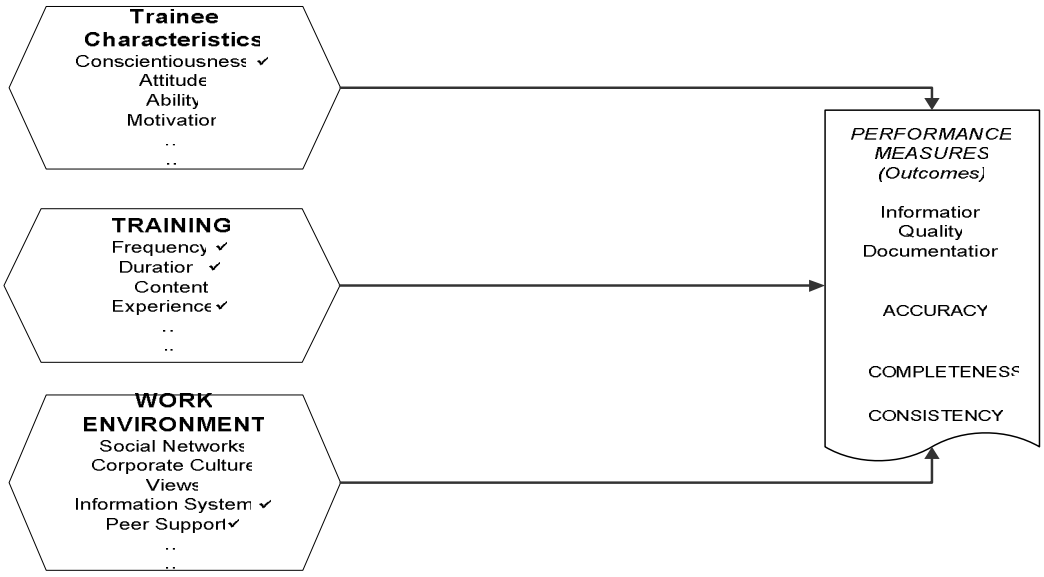


Figure 1-1 Predictors of Information Quality

The research methodology followed in this study is guided by principles of Design Science (DS) discussed in detail in Chapter 3. Data for this study was collected by a mixed method approach which was comprised of 1) a controlled experiment, 2) a Web-based survey and 3) group interviews and discussions. This study employed multiple regression to test the theory and model. Multiple regressions were used because this method allows prediction of the criterion variable (IQ) based on scores obtained from the predictor variables (trainee

characteristics, training design and the work environment) and accounts for variance in the scores of the predictor variables. According to Mertler & Vannatta (2005) multiple regression is most appropriate for predicting a single criterion variable in the presence of multiple predictor variables when all variables are of the interval type. In relation to this research a roadmap is provided (see figure 1-2).

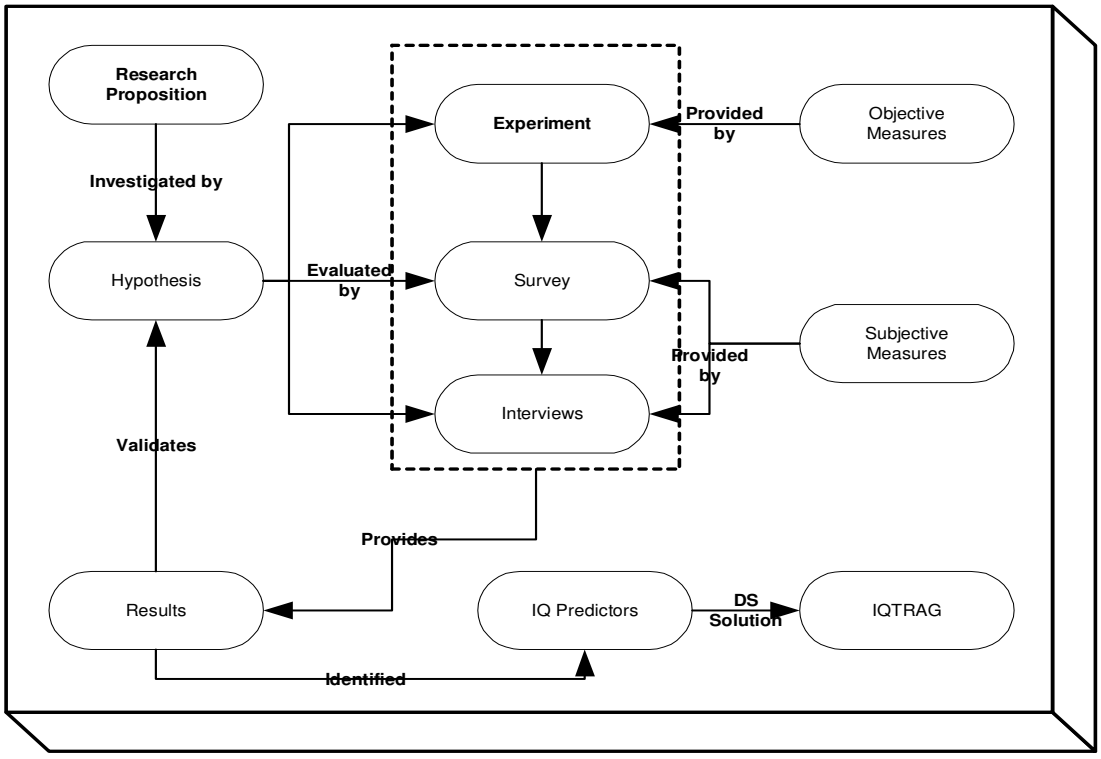


Figure 1-2 Research Roadmap

The results of the analysis led to the development of an Information Quality Training Requirements Analysis Guideline (IQTRAG) to aid in the development of individualised, tailored, Information Quality Training Plans (IQTPs). The contribution to the body of knowledge is threefold: 1) it identifies important influencing factors (training, trainee characteristics and the work environment) of IQ and combines them in a conceptual model: 2) It provides objective and

subjective IQ indicators and measurement instruments within a particular context or task, which allows quantitative assessment of the impact of these constructs on IQ, and 3) it provides an IQTRAG to aid the design of individually tailored, IQTPs.

This contribution is expected to benefit both researcher and practitioner. The model presented is applicable to researchers interested in examining various aspects of relationships between trainee characteristics, training design, the work environment and IQ. Researchers are therefore encouraged to use this model and continue testing its capabilities. They may also benefit from considering the empirical findings of this research when developing research models to examine similar phenomena.

Practitioners can benefit from applying the results of the analysis to their own IQ performance measures and using the IQTRAG in the development of IQTPs. In particular, this research shows that trainee characteristics, training design, documentation recording experience, perception of IQ importance and the work environment are associated with improved IQ.

1.5. Thesis Organization

This thesis is presented in seven chapters. Chapter 1 has outlined the background, motivation, research propositions, research approach and its contribution of the research to the body of knowledge. Chapter 2 presents a review of related work in the IQ and training literature, and gives an overview of the most commonly used IQ frameworks and training models. It reveals a gap in the literature, which highlights the significance of our chosen research area, conceptualises the research model leading to the development of suitable hypotheses and sets this research in its academic context. Chapter 3 presents a research methodology suitable to investigate the research proposition which

is guided by principles of Design Science (DS). Chapter 4 provides an account of the experiment data collection method used in this study and provides the results of the data analysis. Chapter 5 presents an outline of the survey analysis of the data and gives an insight into the relationships between selected IQ predictors and how they impact on IQ. Chapter 6 presents a problem based solution, IQTRAG. Chapter 7 concludes with a summary and a discussion of the main findings, limitations of the study and recommendations for future research.

Chapter 2

REVIEW OF RELATED WORK

2.1. Introduction

Chapter1 introduced the background to the study, the research proposition, and a contribution to the body of knowledge. This chapter presents a review of the related literature relevant to this study. In section 2-1 the Quality Management (QM) literature was explored with a view to tracing the evolution of Information Quality Management (IQM). Total Quality Management (TQM) approaches were also reviewed. TQM literature revealed that IQM was seen to have embedded its theoretical roots in TQM. An overview of Information Quality (IQ) is provided in section 2-2 and a rigorous attempt to find a universally accepted definition of quality section 2-2-1. IQ models, measurements and control initiatives are outlined in section 2-2-2, 2-2-3, and 2-2-4 respectively which led to the research proposition under investigation section 1.3. The importance of training, which is widely recognised as an important factor in organizational performance and training evaluation models, is given in section 2-3. The influence of personality is discussed in section 2-4. Section 2-5 reveals a gap in the literatures which supports the research proposition under investigation and highlighted the need to develop an Information Quality Training Analysis Guideline (IQTRAG) as a practical solution to the identified problem. Section 2-6 gives a brief summary of the chapter.

Every few decades a new management philosophy emerged, which captured the attention of many strategic thinkers in organisations. In the 1960's and 1970's, the focus was on process automation. In the 1980's the leading edge was TQM and in the mid 1990's, the emphasis was on IQM in an attempt to improve quality by performing continuous improvement strategies and thereby, reducing unnecessary costs.

The evolution of quality concepts can be categorised in several phases: quality control, quality management approach and quality processes (Levis et al. 2007). Quality control can be traced to the pre-industrial revolution era, when inspection committees enforced rules for marking goods with a special quality mark to represent a crafts-worker's good reputation (ASQ 2006). Late in the 19th century the United States (US) adopted the scientific management approach developed by Frederick Taylor. Taylor's goal was to increase productivity by assigning inspectors, which led to remarkable rises in productivity but had a negative effect on quality (Fox & Frakes 1997; Stephens & Juran 2005). To correct the quality decline, factory managers created inspection departments to keep defective products from reaching customers and quality was understood as conformance to some standard (Fox & Frakes 1997; Stephens & Juran 2005). In the early 20th century, manufacturers began to include quality processes in practice (ASQ 2006). After the US entered World War II, quality became a critical ingredient of the war effort as bullets made in one state had to work consistently in rifles made in another state (Crosby 1995).

In the 1950's Japanese businesses welcomed the input of 'Quality Management pioneer', Edwards Deming who advised them on quality (Deming 1995; Wheeler & Duggins 1998; Madu 2003). Rather than concentrating on inspection they focused on improving all organizational processes (Beckford 2005). Improvements in quality were seen as a means to increase productivity,

lower costs, and provide the customer with the desired product (Fox & Frakes 1997; Wheeler & Duggins 1998). In 1954, Juran arrived in Japan with his new insights into management's responsibility for improving quality in production (Deming 1995) and with the help of Ishikawa, Japanese quality improved dramatically and captured markets the world over.

By the 1970's, many organisations embraced TQM approaches that involved the entire organization (ASQ 2006). TQM incorporates the ideas of product quality, quality control, quality planning, quality assurance and quality improvement. Thus, TQM is the control of all transformation processes of an organisation, to better satisfy customer needs in the most economical way (Juran 1979; Deming 1982). In essence, the three basic principles of TQM are: 1) focus on customer satisfaction; 2) seek continuous and long-term improvement in all organizations' processes and outputs, and 3) ensure full involvement of the entire workforce in improving quality. An effective TQM effort will need the participation of everybody in the organisation (Omachonu et al. 2004) and good communication between departments is important (Soin 1998). However, the entire total quality effort must be planned and managed by the company's management team (Soin 1998). Most quality management leaders agree that the biggest ingredient, and most critical issue in quality, is the management commitment to support employees who in turn support the customer (Blades 1995; Beckford 2005).

Critical factors identified in QM studies focus on performance measurement (Mann & Kehoe 1994; Oakland 2003), and quality training (Snell & Dean 1992; Blackburn & Rosen 1993). Many constructs can be assigned to human related causes: for example, employee training (Anderson et al. 1995; Black & Porter 1996). Mandal et al. (1998), notes that companies committed to TQM invests in training. Bacdayan (2001), agrees that: 'Training costs may be justified as a long-term investment in TQM skills at the grass-roots level'

Quality pioneer Deming declared that Japanese firms regard their employees as their most significant competitive asset and therefore provide them with good training in specific skills (Deming 1982) and he highlighted that 'the customer is the most important part of the production line'. Bowen (1996) states that organizations should also recognize information as a business asset, and many authors suggest that organisations should define direct management responsibilities for it (Redmond 1995; Pierce 2004; Helfert & Herrmann 2005; Bertoletti 2005). Customers, suppliers, and employees may be adversely affected through poor service, billing errors, and inconvenience and such negative effects are often revealed in the direct and indirect costs of correcting data errors (US Dept of Defence 1997).

2.2. Information Quality Management

This section examines the literature addressing Information Quality Management (IQM). The goal of IQM is to increase business effectiveness by removing the costs of poor IQ and increasing the value of high-IQ assets (English 2002b). Many researchers and academics give elaborate definitions of the differences between data, and information. Data is a collection of discrete objects, facts or events that is out of context. It is also known as unprocessed information. Inside the spread sheet of excel in each cell we store data, on its own it does not give any information. For example when we store the accuracy level of the patient care document in a spread sheet we call it data. We may do some categorization on the data to get a meaningful output from it. The processed data is known as information. From a collection of data we can derive meaningful information (conclusion). The accuracy figure stored in a spread sheet on its own can't give any conclusion but on observation or by statistical tools we may see that the accuracy levels of trained employees are better than the accuracy levels of untrained employees. This is the information we can get out of the accuracy data. Another example is the recorded blood

pressure of a patient is known as Data. By the process of checking the blood pressure of the patient we can say that the patient is having high blood pressure. This is information as we are able to get a meaningful conclusion from the blood pressure readings.

However some researchers do not distinguish between Data quality (DQ) and IQ and the use of the terms IQ and DQ *is* considered by many researchers to be synonymous (Bovee 2004), In business practice such distinctions, while intellectually interesting, are peripheral to the main information quality focus. Information managers have a much clearer idea which people are crucial to their firm's success more than they do about distinctions between information and data.I In this thesis the terms data and information is used interchangagly.

The concern for better IQ is reflected by efforts to model, improve, measure and define it (Dillard 1992; Jang et al. 1992; Wang & Kon 1993; Wang & Reedy 1993; Wand & Wang 1996) see table 2-1. Several researchers have developed quantitative models to help IS developers evaluate, improve, and manage data accuracy (Morey 1982; Ballou & Pazer 1985; Paradice & Fuerst 1991; Bowen 1992). Wang et al. (1995), provides an overview of data quality methodology. Some researchers promote Total Data Quality Management (TDQM), to improve IQ (Wang & Kon 1993). Huh et al. (1990), Wang & Kon (1993), Huh et al. (1994) recommend using statistical process control (SPC) to measure, control, and improve IQ.

Table 2-1 Products Vs Information Manufacturing Wang (1998)

Methodology	Description	Main Reference
TDQM	Total Data Quality Management	Wang 1998
TIQM	Total Information Quality Management	English 1999
AIMQ	A methodology for information quality assessment	Lee et al. 2002
DQA	Data Quality Assessment	Pipino et al. 2002

High-IQ is a result of IQM and serves as a lever to quality success. However, there are many reasons why an IQM effort fails. Chiefly, senior managers are sometimes looking for immediate solutions rather than long-term quality improvement and fail to understand that IQ must be embedded in the culture and environment of the organization. Research suggests that IQ problems have a significant economic impact that can cause serious financial problems for organizations. Wang et al. (2001) declared that 70 percent of manufacturing orders are assessed as being of poor IQ. According to Olson (2003), in 599 surveyed companies, poor IQM costs more than $1.4 billion yearly.

To address the challenges related to quality, notable research attention has focused on the need for a rigorous definition of quality. One of the most problematic issues confronting researchers today in QM is that there is no universal definition. However, there are many attempts to define IQ (Wand & Wang 1996; Tayi & Ballou 1998; Huang et al. 1999). Early work focused on identifying the important characteristics that define IQ (Redmond 1996; Wand & Wang 1996; Wang & Strong 1996). Defining IQ has proved to be a complex issue (Ballou & Pazer 1985; Wand & Wang 1996; Wang & Strong 1996; Redmond 1996; Ballou et al. 1998; Huang et al. 1999; Klein 2001). However, most commonly, the term IQ is described as that which is ‘fit for use’ (Wang &

Strong 1996; Ballou & Tayi 1999). Other common definitions are outlined in section 2.2.1.

In another respect Wang (1998) proposed a TDQM framework that adapts the widely used Deming quality cycle to encompass a continual cycle: 1) define: what IQ means to the user; 2) measure: to provide IQ information through measuring data collections; 3) analyse: what IQ do we need and where should our priorities lie and 4) improve: carry out improvement initiatives (Kovac et al. 1997; English 1999; Wang et al. 2001). Fundamental to the TDQM process is that information is treated as an Information Product (IP), a valuable asset that should be produced as part of a well-defined production process, rather than the traditional view of data as a by-product (Ballou et al. 1998; Wang et al. 1998). A process is 'a structured, measured set of activities designed to produce a specified output for a particular customer', such as a bank statement or a hospital discharge summary. Many authors highlighted the importance of paying attention to the process (Wang et al. 1998; Helfert & Herrmann 2005; Scannapieco et al. 2005; Katz-Haas & Lee 2005). The objective of TDQM is to deliver high-quality IPs to information consumers.

The multidimensional nature of information and therefore, IQ requirements means that TDQM encompasses the existing practices of 'find and fix' and adds the dimension of prevention. To meet this need the MIT IQ research group developed data production maps (Ballou et al. 1998) that use data flow diagram (Wang et al. 1998). The flow of information is important in understanding the nature of the information. In IQ studies, four roles within the information manufacturing life cycle have been identified namely producers, custodians, consumers, and managers (Strong et al. 1997; Wang 1998). Producers are those who produce or collect the information: custodians are those who handle and manage the storage of information: consumers are those who use the information in their work activities and managers are those

responsible for managing the entire IQ in the organisation. One innovative approach for ensuring satisfactory IQ is to examine information manufacturing as product manufacturing (Paradice & Fuerst 1991; Wang & Strong 1996; Ballou et al. 1998; Wang et al. 1998; Shankaranarayanan et al. 2000; Scannapieco et al., 2005). Product manufacturing can be viewed as a processing system that acts on raw materials to produce physical products. Similarly an information processing system acts on raw data to produce an IP. Wang's model is shown in table 2-2.

Table 2-2 Products Vs Information Manufacturing Wang (1998)

	Product Manufacturing	**Information Manufacturing**
Input	Raw Materials	Raw Data
Process	Assembly Line	Information System
Output	Physical Product	Information Product

The underlying concept of an IP is the information output from an information manufacturing system has value that is transferable to the customer. Four roles are identified as follows:

- *Information suppliers* are those who create or collect data for the IP.
- *Information manufacturers* are those who design, develop, or maintain data and systems infrastructure for the IP.
- *Information consumers* are those who use the IP in their work.
- *Information product managers* are those who are responsible for managing the entire IP production process throughout the IP life cycle.

An IP has value that can be transferred to the information consumer. Therefore, like a physical product, an IP has quality dimensions and these can be viewed as fitness for use by the information consumer. There are some differences between product manufacturing and information manufacturing

(Ballou et al. 1998). For instance, the raw materials used in information manufacturing are data, which can be consumed by more than one consumer without depletion unlike raw materials in product manufacturing that can only be used for single physical products (Paradice & Fuerst 1991; Ballou et al. 1998; Wang 1998; Shankaranarayanan et al. 2000). Redman (1994) states that information differs from manufactured products in critical ways. He states that:

> "A*s with the quality of manufactured goods, high-quality* information *stems from well-defined managed processes that create, store, move and manipulate, process and use it. Thus,* information *quality involves 'getting the right and correct* information *in the right place at the right time to complete the task at hand."*

Information is the product of the business process that creates or updates it. The IP becomes the supply material or input for many other business processes. This implies supplier customer roles (Beckford 2005). As a product of a process the same principles of quality improvement that Deming, Crosby, and Juran, applied to manufacturing processes to improve product quality, can be applied to business processes to improve IQ. Pierce (2004) recommends focusing on the information production process that can be defined as 'the results of manufacturing raw data into valuable information'. However, information cannot be separated from its use. A database that provides high-IQ for one specific use could provide poor IQ for another (Olson 2003). Quality implies that information should be accurate and complete and quality measures should be appropriate and context adjustable. A straightforward definition of context is that it is the set of circumstances or events that form the environment where something takes place. It mirrors Crosby's definition of quality, detailed in section 2-2, where non-IQ often begins during requirements definition and if not handled correctly the information product may be good quality to some and poor quality to others (Olson 2003). To this end, (Wang & Strong 1996) outline various IQ attributes from the perspectives of those who use the information.

Information is of high-quality 'if it is fit for its intended use' (Kumar & Tayi 1998; Olson 2003; Bugajski et al. 2005).

For a few decades, researchers have also looked at various ways to conceptualize and define IQ dimensions such as usefulness, desirability, and meaningfulness (Gallagher 1974), accuracy, relevance, completeness, recoverability, access security, and timeliness, precision, currency (Bailey & Pearson 1983). Ballou & Pazer (1985) expanded the definition of IQ beyond accuracy, stating that IQ also 'includes timeliness, consistency, completeness, relevance, and reliability'. The most important classifications of quality dimensions are provided by Wand & Wang (1996); Wang & Strong (1996) Redman (1996); and Bovee et al. (2004). By analyzing these classifications, it is possible to define a basic set of data quality dimensions, including 1) accuracy, which means the recorded value conforms to the real world value, 2) completeness, the degree to which values are present (Ballou & Pazer 1985), and focuses on whether all values for a certain variable are recorded, 3) timeliness, which means the recorded value are up-to-date (Ballou & Pazer 1995; Wang et al.1994; Klein, et al. 1997), and 4) consistency, which means representing the values in the same format at all times (Wang & Strong 1996; Redmond 1996; Ballou & Pazer 1985).

Wang & Strong (1996), state that quality of information depends on IQ dimensions. Table 2-3 shows the dimensions with a brief description of each. They proposed an IQ framework that included categories of intrinsic, accessible, contextual and representational information quality (table 2-4).

Contextual IQ contains 5 dimensions: value-added, relevancy, timeliness, completeness and an appropriate amount of data, and it highlights the requirement that data must be considered within the context of the task in hand. It must be relevant, timely, complete, and appropriate in terms of

amount, to add value. Representational IQ includes 4 dimensions: interpretability, ease of understanding, representational consistency and concise representation, and requires that information be consistently represented. Information is of little value if it is not accurate which falls in the intrinsic IQ category. Intrinsic quality comprises 4 dimensions: believability, accuracy, objectivity and reputation. Accessibility IQ consists of 2 IQ dimensions: accessibility and access security. In a study by Strong et al.(1997) projects from a hospital, to examine information quality in context found that missing and inconsistent information were the root of many IQ problems.

Table 2-3 Dimensions of Information Quality (Wang et. al 1996)

Dimension	Description
Access Security	Access to data must be restricted, and hence, kept secure.
Accessibility	Data must be available or easily and quickly retrievable.
Accuracy	Data must be correct, reliable, and certified free of error.
Appropriate Amount of Data	The quantity or volume of available data must be appropriate.
Believability	Data must be accepted or regarded as true, real, and credible.
Completeness	Data must be of sufficient breadth, depth, and scope for the task at hand.
Concise Representation	Data must be compactly represented without being overwhelming.
Ease of Understanding	Data must be clear, without ambiguity, and easily understood
Interpretability	Data must be in appropriate language. Units and definitions must be clear
Objectivity	Data must be unbiased (unprejudiced) and impartial
Relevancy	Data must be applicable and helpful for the task at hand
Representational Consistency	Data must be presented in the same format as previous data
Reputation	Data must be trusted and highly regarded by source and content
Timeliness	The age of the data must be appropriate for the task at hand.
Value-Added	Data must be useful and provide advantages from their use.

Table 2-4 Categories of Information Quality Wang et. al. (2006)

Categories of Information Quality Dimensions		
Category	Dimensions	Deficiencies May Indicate
Intrinsic	Accuracy Objectivity Believability Reputation	A lack of process or weakness in the current process for creating data values that correspond to the actual or true values.
Contextual	Value-Added Relevancy Timeliness Completeness Appropriate Amount of Data	A lack of process or weakness in the current process for producing data relevant to the tasks of the user.
Representational	Interpretability Ease of Understanding Representational Consistency Concise Representation	A lack of process or weakness in the current process for supplying data that is understandable and clear.
Accessible	Accessibility Access Security	A lack of process or weakness in the current process for providing readily available and obtainable data.

Wang et al. (1998), presents an IQ assessment methodology called AIMQ. The AIMQ consists of three components: 1) Product-Service-Performance model which divides a fixed set of IQ criteria into four classes 2) a resulting questionnaire of 65 assessment items is developed, and 3) two analysis techniques comparing the questionnaire results of different stakeholders of an information manufacturing system. Both techniques are executed on each of the IQ categories separately (figure 2-1).

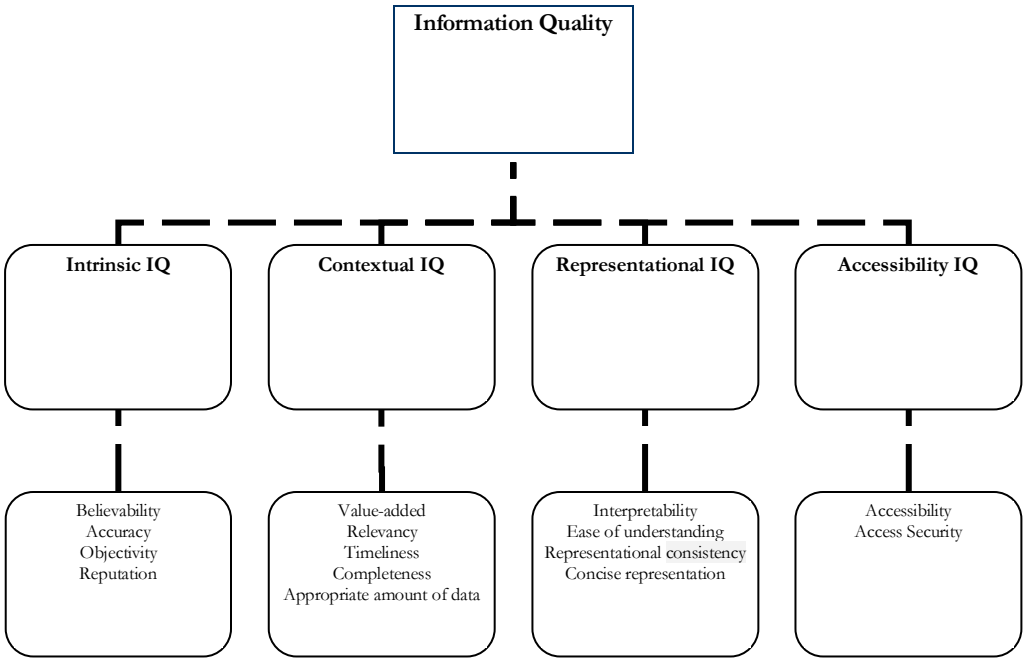


Figure 2-1 Information Quality Framework Wang & Strong (1996)

Lee et al. (2002) carried out a correlation analysis of the 15, IQ dimensions with 261 subjects based on the works of (Wang & Strong 1996) and their results found high correlations between the dimensions which would suggest that IQ dimensions are not innately independent. Therefore, to gain further insight into IQ, the literature was searched, which predominately focused on determination of rigorous definitions of quality, discussed next.

2.2.1. Quality Definitions

The existing literature suggests that the quality of information is a vaguely defined concept (Eppler 2006). Various definitions of quality are to be found in a wide range of literatures. However, precisely defining such a multi-facetted construct as 'quality' has proved to be complicated and to the present-day there is no single established definition for it and a unanimously accepted definition of quality has not been agreed. However, there are many definitions widely discussed in the literature. Smith (1993) defines quality in this way*:*

> "Quality is the goodness or excellence of any product, process, structure or other thing that an organization consists of or creates. It is assessed against accepted standards of merit for such things and against the needs of producers, consumers and other stakeholders."

An important aspect of Smith's definition is that quality means different things to different people and organizations. There is consensus that quality is contextual and dynamic. The decisive factor that defines better or worse quality can vary from one context to another (Strong et al.1997). Although definitions may vary from organization to organization, many researchers agree that effective quality initiatives involve every employee in the organization and that training and communication are important factors in organizational efforts to improve quality (Goodden 2001; Hansson 2001).

Juran (1989), an important contributor to the quality movement, highlighted the importance of the 'customer' in defining and measuring quality. He defined customers as 'all people who are impacted by processes and products'. He described internal and external customers as everyone involved in the processing or handling of a product until it reached the end user. Juran proposed a definition of quality as 'fitness for use'', which measure the extent to which a product successfully serves its proposed role.

Deming (1982), one of the earliest pioneers of QM, also highlighted that the customer was the most important part of the production line and Crosby mirrored both Deming and Juran, by stressing the role of the customer as being an important element in quality (Crosby 1996). Crosby defined quality as 'conformance to requirements' and this definition has been widely accepted as 'the standard' for many years.

Quality as 'conformance to specifications' is a position that people in the manufacturing industry often promote. Manufacturers can decide the quality of their products by measuring how well the product conforms to a defined

specification. However, it fails to capture the customer's expectations of the product. Others uphold the idea that the product or service being delivered: a) meets customer standards: b) meets and fulfils customer needs, and c) meets customer expectations (*Kahn* et al. *2002*). This definition is common in marketing research and the service industries. An acceptable level of quality is achieved if the information conforms to a defined specification and the specification correctly reflects the intended use (Huang et al. 1999: 34). This fits well with all the traditional references that describe quality as 'fitness for use*',* fitness for purpose', 'customer satisfaction' and 'conformance to requirements' (Crosby 1980; Juran 1989).

Crosby is credited with the concept of 'zero defects', which is based on the view that it is cheaper to prevent defects than to correct them. Table 2-5 shows five different ideas of quality types and their definitions. The customer based definition states that consumers have different wants and products that best satisfy user preferences are regarded as high-quality. The manufacturing based definition focuses on supply side and is primarily concerned with the production processes. The product based view defines quality as a measurable variable. The user-based definition states that quality is determined by the user. The value-based definition considers cost and price and a quality product is one that provides performance at an acceptable price and the transcendent view defines quality as 'excellence' or high standards.

Table 2-5 Definitions of Quality

Type	Definition of Quality
Customer Based	Fitness for use, meeting customer expectations as stated by the customer.
Manufacturing Based	Conforming to design, specifications, or requirements related to production process.
Product Based	Product has something other similar products do not and it is measurable.
Value Based	Product is the best combination of price, costs and features.
Transcendent	It is not clear but it is something beyond excellence.

The International Organization for Standardization (ISO) also supplies an acceptable definition of quality by using accepted terminology from the quality field. Their documented agreements contain technical specifications and other criteria to be used as guidelines to ensure that materials, products, processes and services are fit for their purpose. ISO presents a formal definition of quality as:

> *"The totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs* (ISO 9000 Bureau of Business Practice 1992). "

In 2001, the Institute Of Medicine's Committee on the Quality of Health Care in America issued a report where they defined quality as:

> *"The degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge* (Institute of Medicine 2001). "

American Society for Quality (ASQ) defines quality as follows:

> *"Quality denotes an excellence in goods and services, especially to the degree that they conform to requirements and satisfy customers* (American Society for Quality 2006)*."*

Regardless of the differences in IQ definitions, researchers in the management, communication and information technology (IT) literatures have built a surprising consensus around conceptual frameworks and lists of IQ criteria that can be used to describe the characteristics that make information useful for its users (Khan et al. 2002).

The definition of the quality, *dimensions*, and *metrics* to assess information quality is a critical activity. Some researchers have stated that IQ is a measure of the information views in a database against the same information in the real world (Orr 1998). Traditionally, IQ has only been described from the

perspective of accuracy. Research and practice signal that IQ should be defined beyond accuracy. The criterion is identified as encompassing multiple dimensions. The information quality literature provides a thorough classification of information quality dimensions; nevertheless, there are a number of discrepancies in the definition of most dimensions due to the contextual nature of quality. From the perspective of defining the gap between the quality of service provided and the quality of service expected, quality is perceived and evaluated as the extent to which a service meets or exceeds the expectations of customers. This can be both one of the most complex and most accurate ways to define quality. In view of this, organizations now assess their management systems and performance against business excellence models, as they provide a recognized approach for evaluating organizational quality performance and comparing their performance with the quality performance of other organizations discussed in section 2-4.

2.2.2. Information Quality Models and Frameworks

Some frameworks are suitable for evaluating the quality of information provided. The perspective of an information producer on the quality of information may differ from that of an information consumer, so it is ultimately the information consumers who assess whether the information is fit for their uses. Therefore, the quality of the information cannot be assessed independently of those using the information (Strong et al. 1997).

Since the information revolution, information is being considered more and more as a resource to be produced, transformed and used in the same way as industrial material resources. Information on its own has no value, but only has value in the way that it is communicated, exchanged and interpreted. According to Pierce (2004) the Information Products approach to quality is of more importance than the system that produces it. Several root causes of IQ

problems exist: untrained information producers: defective information and application design: redundant databases, and ill-defined, broken or out of control processes (English 2003).

Redman (1998) and Orr (1998) present a cybernetic model of IQ that views organizations as made up of closely interacting feedback systems linking IQ to its use in a feedback cycle (figure 2-2) where the actions of each system are continuously changed by the actions, changes and outputs of other systems (Orr 1998; Redmond 1998; Beckford 2005). Information is deemed of high-quality if it 'correctly represent the real-world construct to which it refers, so that products or decisions can be made' (Orr 1998). IQ thus would refer to the degree of match: a 100 percent would mean there is a perfect match between the real world and the Information System (IS) whereas 0 percent would suggest there is no match.

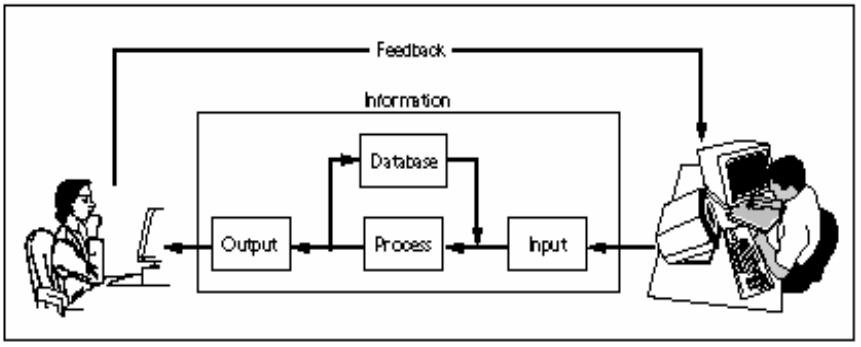


Figure 2-2 Information System in the real World Context (Orr 1998)

As IQ defects are identified by comparing the IS with the represented part of the real world (Helfert et al. 2002), it is important to have a clear picture of what the real world is. A good IS should be a 'proper representation' of a real-world system (Wand & Wang 1996). According to (Wand & Wang 1996) both the real world and IS are systems described in terms of states and laws where there is an exhaustive mapping from the real-world system to that of the IS,

which allows unique inference of the state of the real world from the state of the information system (IS). In general the success of an IS can be evaluated through the IQ provided to the users and the impact of IS on users' thinking, decisions and actions. The response obtained from the Information System is evaluated in terms of appropriateness with the users' needs and expectations, relevance of IQ, and reliability of information.

Much influential IQ research originated from IS research. IS researchers initially identify and employ a set of dimensions and models to address IQ problems within IS. One typical model to explain this is the DeLone & Mclean (1992) Information System Success Model, which defined six major success categories and dimensions: system quality, IQ, IS use, user satisfaction, individual impact, and organization impact for IS success. System quality and IQ singularly or jointly affect both use and user satisfaction. The amount of use can positively or negatively affect user satisfaction. Similarly, user satisfaction can positively or negatively affect use. Both of these aspects impact the individual or users' behaviour. Attributes can include information recall of information entry. Collective individual impact will affect the organizational performance (Seddon et al. 1999).

The relations between the dimensions are presented in the model as follows: system quality (SQ) is assessed with SQ attributes (usability, accessibility, portability, ease of use) and IQ is assessed with IQ attributes (accuracy, completeness, timeliness etc.) leading to system use. System use refers to system usage and information usage. Attributes of usage are the number of entries, or total data entry time. User satisfaction is concerned with the system design or its information. These two are interdependent. Use and user satisfaction have an individual impact that leads to organizational impact (figure 2-3). In a follow-up study, DeLone & McLean (2003) proposed an adjusted

taxonomy adding service quality as a dimension, and combining individual and organizational impacts into a single dimension.

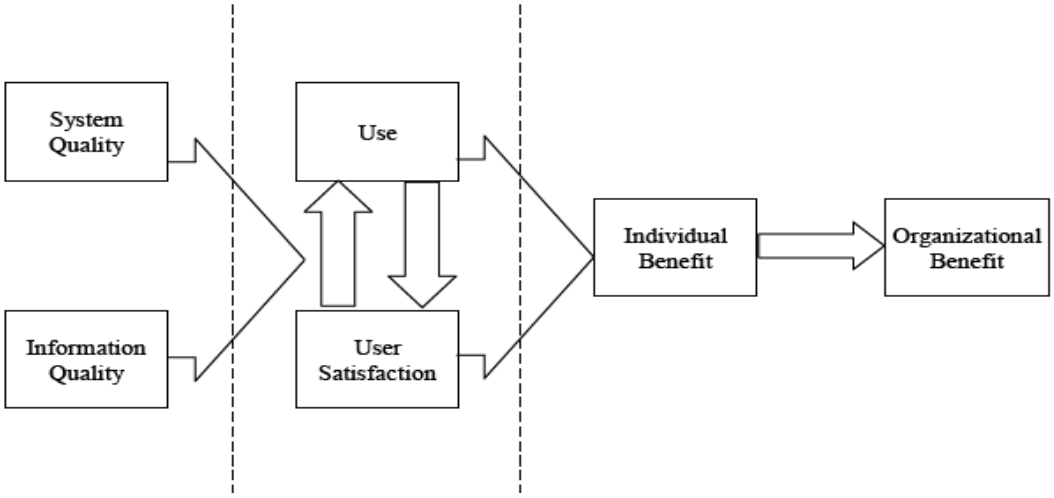


Figure 2-3 DeLone & McLean Model for IS Success

Many authors believe that information should be treated as both a product and a service. The literature draws distinctions between product quality and service quality (SQ) of information (Zeithaml et al. 1990). Product quality includes product features that involve the tangible measures of IQ, such as accuracy and completeness. SQ includes dimensions related to the service delivery process and intangible measures such as ease of manipulation, security and added value of the information to consumers (Khan,et al. 2002).

Defining SQ and its components in a way that is usable in an organisation is an important endeavour for many organisations. However, an all embracing definition of SQ is difficult to produce. Parasuraman et al. (1985) describe Service Quality as the ability of the organisation to meet or exceed the customers' expectations. Parasuraman et al. (1985) also advocate five dimensions to determine SQ assurance (knowledge and courtesy of employees and their ability to inspire trust and confidence); empathy (caring,

individual attention the organisation provides to its customers); reliability (ability to perform the promised service dependably and accurately); responsiveness (willingness to help customers and provide prompt service), and tangibles (appearance of physical facilities, equipment, personnel and communication materials).

Some authors believe while 'information' can be captured, stored, accessed and processed, the human experience underpinning it and making sense of it cannot. Incidentally, Miller (2002) states we must realise that 1 = 0. This implies that information has no intrinsic meaning. He also believes that knowledge is a means by which we make meaning from information, usually in a face-to-face meeting with other people. Often the intended meaning of the message relayed to others can be misinterpreted resulting in undesired outcomes.

> "I know you believe you understand what you think I said –but I'm not sure you realise that what you heard is not what I meant!" (Ashleigh Brilliant).

From the KM literature, Nonaka & Takeuchi (1991) provided a framework for distinguishing between explicit and implicit knowledge and the conversion processes between them. According to Nonaka and Takeuchi, tacit knowledge embodies beliefs and values and is actionable. In contrast, explicit knowledge is codifiable into artefacts such as documents. Transmitting knowledge from one individual to another can take the forms shown in table 2-6.

Table 2-6 Conversion of Knowledge (Nonaka & Takeuchi (1995)

CONVERSION	PROCESS	FACILITATING TECHNOLOGIES
Tacit to Tacit	Socialization	Sharing knowledge through social interactions (Chat) face-to-face communication
Tacit to Explicit	Externalization	Takes the shapes of metaphors, analogies, concepts, hypotheses, or models (Chat) articulate the knowledge and know-how
Explicit to Explicit	Combination	Recombining discrete pieces of explicit knowledge into a new form.(Visualization of data)
Explicit to Tacit	Internalization	Diffusing and embedding newly acquired and consolidated knowledge (Text search, document categorization) Internalization is strongly linked to "learning by doing".

Nonaka identifies four basic patterns for creating knowledge in any organization. The four conversion processes they describe are:

- Tacit-to-tacit (socialisation) where individuals acquire new knowledge directly from others communicated through mechanisms like observations, conversation and on-the-job learning. The tacit aspects of knowledge are those that cannot be codified, but can only be transmitted via training or gained through personal experience. As apprentices learn the craft of their masters through observation, imitation, and practice, so do employees of a firm learn new skills through on-the-job training.
- Tacit-to-explicit (externalisation) articulating knowledge into tangible form through dialogue. Tacit knowledge is not easily shared. The process of transforming tacit knowledge into explicit or specifiable knowledge is known as codification, articulation, or specification. Effective transfer of tacit knowledge generally requires extensive personal contact and trust. According to Nonaka & Takeuchi (1995), externalization of tacit knowledge is induced by dialog and collective reflection. Groupware helps this process by permitting collaboration and exchange of non-structured messages. Discussion groups and chats are common groupware

applications that make possible the gradual articulation of tacit knowledge..

- Explicit-to-explicit (combination) combining different forms of explicit knowledge such as that in documents or databases. Documents are an efficient way to exchange explicit knowledge that, when organized and combined, can lead to new knowledge. In organizations, members combine their explicit knowledge by exchanging reports and a variety of other documents.
- Explicit-to-tacit (internalisation) such as learning by doing where individuals internalise knowledge from documents into their own body of experience. Training is an appropriate tool to systematize and add quality to information that is dispersed through departments. Organizations provide training programs for its employees at different stages of their working with the company. By reading training manuals and documents employees internalize the tacit knowledge.

The socialisation mode starts with building a field of interaction facilitating shared experience and mental models. This triggers the externalisation mode by meaningful dialogue and collective reflection where the use of analogy helps articulate tacit knowledge which is otherwise hard to communicate. The combination mode is triggered by networking newly created knowledge with existing knowledge and finally learning by doing triggers internalisation. These modes of knowledge interact with each other (figure 2-4).

From the IQ literature, (Huang et al. 1999) connected IQM and KM through the relationship between information and knowledge. They proposed a three process framework: improve IQ: make tacit knowledge explicit and create organisational knowledge. However, one cannot manage IQ without having measured it effectively and meaningfully (Stvilia et al. 2007). The next section presents a brief discussion of IQ measurement.

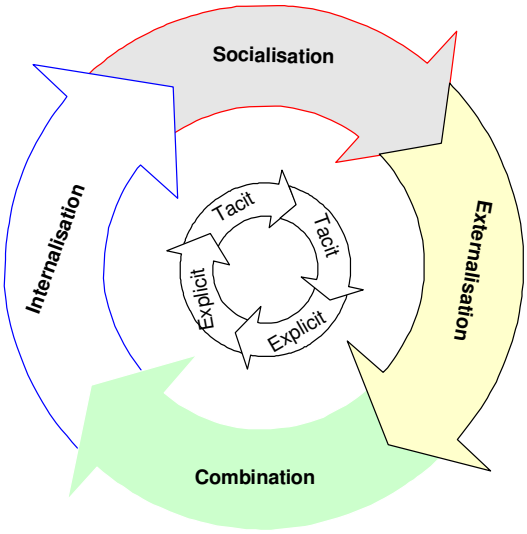


Figure 2-4 Nonaka & Takeuchi (1991) Conversion Model

2.2.3. Measuring Information Quality

Improving the ability to measure quality has been an object of significant interest for the public and private sectors for the past decade, reflecting the notion that measurement can serve as a tool for improvement. Valid quality measures are integral to an organisations' efforts to improve performance. The field of IQ evaluation has been extensively researched (Wang et al.1995; Lee et al. 2002; Eppler 2006). While notable advances have been made in the quality measurement field, in recent years efforts still fall short of meeting the users' IQ needs. Several definitions are provided for the term *accuracy*. Wang & Strong (1996) define accuracy as 'the extent to which information are correct, and reliable'. Ballou & Pazer (1985) specify that information is accurate when the information values stored in the database correspond to real-world values. Completeness is defined as the degree to which a given information collection includes information describing the corresponding set of real-world objects. The consistency dimension refers to the violation of semantic rules defined over a set of information items.

There is great difficulty in measuring IQ. 'More often than not, the information available is not like the real world that it is meant to represent' (Redmond 1995; Wand & Wang 1996). Currently, there are a number of different approaches for measuring IQ. On the one hand IQ can be measured with subjective perceptions from information users, and on the other hand it can be measured based on the intrinsic quality characteristics of completeness and accuracy. Most IQ assessments fall into either objective or subjective methodology (Pipino,et al. 2002).

Subjective assessment methodologies typically use surveys or interviews with information consumers to measure IQ. Lee et al. (2002) developed a measurement instrument known as the Information Quality Assessment (IQA) which measures perceptions of each dimension of (Wang & Strong 1996) model. This instrument has been used as the basis of several studies requiring IQ measurement (Khan et al. 2002; Pipino et al. 2002; Pipino et al. 2005). Despite the quantitative nature of the measurements, these are subjective as they are based on human perceptions and subject to human interpretation of the state of IQ and the meaning of the questions asked.

There is much difficulty associated with measuring IQ objectively. According to the New Zealand Health Sector, IQ dimension *'accuracy' is defined within the framework as 'how well information reflects the reality they are supposed to represent'.* Yet, from the literature reviewed not one definition can be found for even these most commonly used IQ dimensions (Wand & Wang 1996). Therefore it is important to explicitly define each dimension.

Wand & Wang (1996), used an ontological perspective to develop rigorous definitions of the dimensions. For example, an IS, is inaccurate if it *'represents a real world state different from the one that should have been represented'.*

Redman (2005), proposed a set of accuracy metrics: the ratio of the number of items judged correct to the number of items tested. A more generic set of metrics is proposed by Pipino et al. (2002), who specified three basic functional forms: simple ratio: minimum or maximum operator, and weighted average and all metrics are normalised to a value of between zero and one, with one being seen as the ideal. The simple ratio proposes measuring the error-free rate by dividing the number of units in error by the number of units tested. The simple ratio is considered useful for measuring completeness, consistency, accuracy and conciseness (Pipino et al. 2002).

With measuring IQ either subjectively or objectively, both these approaches fall short of Wang & Strong (1996) suggestion for 'an overall IQ metric'. Pipino et al., (2002), proposed a simple two-by-two grid with high-low subjective assessments on one axis and objective assessments on the other. Mapping onto one of the four quadrants can be used as an overall gauge of IQ (Pipino et al. 2005). Some IQ objective measures can be checked against original information. This is an accepted 'metric' in IQ, where the user of the information makes a subjective decision about the fitness of use for the user's current purpose (Pipino 2002). Many quality control efforts have been described in the literature. The following section gives an understanding of some quality improvement initiatives.

2.2.4. Quality Control Initiatives

For many years, statistical quality techniques have been used to improve product quality in manufacturing and by applying these techniques, organisations can provide continuous improvements to all organizational processes (Redman 1994). The Deming approach used data analysis tools such as control charts as a device to estimate process parameters such as the mean and standard deviation of nonconforming item lines (Montgomery

1991; Leitnaker 1996). Cause and effect diagrams display sources of data errors and simplify the discovery of problems. Pareto charts show the frequencies of events and help compare causes of quality problems (Leitnaker 1996). Deming's plan-do-check-act cycle is a four-step process for quality improvement (figure 2-5). Step 1: develop a plan to effect improvement; Step 2: carry out the plan; Step 3: observe and check effects of the plan and Step 4: study results to discover what was learned.

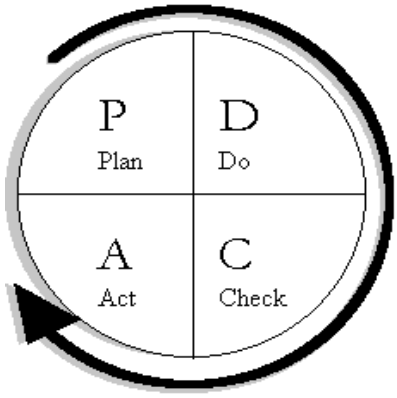


Figure 2-5 The Deming Plan, Do, Check, Act Cycle

Deming also created fourteen major points that are widely used in business (table 2-7). These include such items as to create constancy of purpose, institute training, drive out fear, and break down barriers.

Table 2-7 Deming's 14 Points of Quality Management

DEMING'S 14 POINTS ON QUALITY	
1. Constancy of purpose for improvement of quality	8. Job satisfaction
2. Adopt new management philosophy	9. Barriers between departments
3. Understand the purpose of inspection	10. Slogans and targets
4. Relationship between organization and supplier	11. Goals for management
5. Continuous improvement of every process	12. Pride in workmanship
6. Training and education	13. Training and education
7. Leadership	14. Management transformation

Crosby's key idea - 'do it right first time' highlighted culture change and identified areas in which quality can be improved: improving awareness;

establishing teams; setting goals; giving recognition; and continuously repeating the quality improvement cycle (Crosby 1995; Beckford 2005). Crosby (1992) stated that 'the only absolutely essential management characteristic is for an organization to deliberately give customers exactly what they want' thus stressing the important role of the customer.

Feigenbaum (1991) divided quality costs into four categories: 1) internal failure costs associated with defects found before the customer receives the product or service; 2) external failure costs representing costs associated with defects found after the customer receives the product or service; 3) appraisal costs representing costs incurred to find out the degree of conformance to quality requirements, and 4) prevention costs representing costs of all activities specifically incurred to keep failure costs to a minimum (Crosby 1995) (table 2-8).

Table 2-8 Types of Costs According to Feigenbaum

Types of Costs	Description
Internal failure costs	Costs associated with defects found before customer receives product/ service
External failure costs	Costs associated with defects found after customer receives product or service
Appraisal costs	Costs incurred to determine degree of conformance to quality requirements
Prevention costs	Costs incurred to keep failure and appraisal costs to a minimum

To manage quality, Juran divided the quality effort into what he called a 'trilogy', which is a three-legged approach of quality management processes: quality planning (developing products and processes to meet the customer's needs by discovering who the customers are and what their needs are); quality control (improving quality levels by lowering defects thus reducing costs, improving customer satisfaction and meeting goals), and quality improvement (continuously improving the quality process) (Crosby 1995; Stephens & Juran 2005) (table 2-9).

Table 2-9 Quality Effort According to Juran

Processes	Description According to Juran
Planning Process	Discover who the customers are and their needs
Control Process	Improving quality levels by lowering defects, reducing costs, and improving customer satisfaction
Improvement Process	Continuously improve the process quality

Ishikawa believed a culture of continuous improvement is born from management responsibility (cited in Crosby 1995) and in 1943 developed the cause and effect (fishbone) diagram to aid in improving quality (Stephens & Juran 2005; Bauer 2006), figure 2-6.

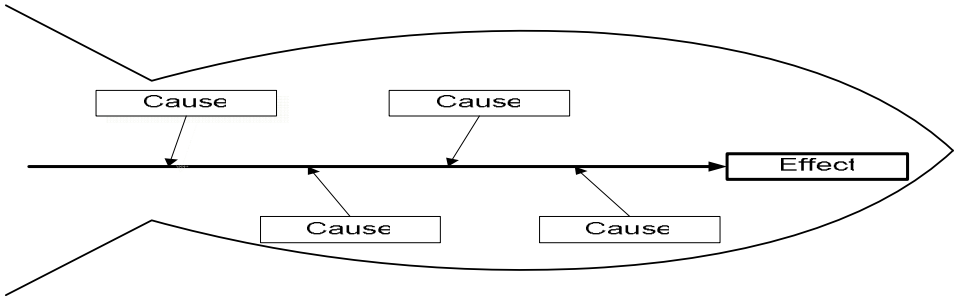


Figure 2-6 Ichiro Ishikawa's Cause and Effect Fishbone Diagram

Ballou and colleagues conducted extensive research on effect of information errors on IS outputs (Ballou et al. 1987; Ballou & Pazer 1995; Ballou et al. 1998; Ballou & Tayi 1999). Ballou & Pazer (1985), presented a model for analysing the effect of information errors. IS and the quality of the information they contain affect customers' perceptions of the quality of purchased products and services (Wang et al. 1995; Wang & Strong 1996).

In 1987, to encourage and improve international competitiveness the late US Secretary of Commerce, Malcolm Baldrige, set up the National Quality Award, which evaluates businesses on certain criteria. The award stresses customer satisfaction and a proactive rather than reactive approach to Quality Management (Mahoney & Thor 1994; National Institute of Standards and

Technology 2005). This quality award program helps stimulate companies to improve quality and productivity while gaining a competitive edge through increased profits. Other formal evaluation models of QM developed are the Deming Prize in Japan and the European foundation for Quality Management (EFQM) model in Europe.

The criteria of the annual Deming Prize(s) set up in 1950 and managed by the Union of Japanese Scientists and Engineers (JUSE) include policies, organization, information, standardization, human resources, quality assurance, maintenance, improvement, effects and future plans. The philosophy of Deming is the key feature to the prize.

In recent times, many organizations assess their management approaches, IS and performance against business excellence models. The European Foundation for Quality Management (EFQM) is a non-profit organisation created in 1988 by fourteen leading European businesses with the mission to *'be the driving force for sustainable excellence in Europe*'. The EFQM is a framework comprised of nine criteria used to access an organisation's progress towards excellence about performance, people and society. This is achieved through leadership policy and strategy, people, partnership, resources and processes. The mission of EFQM is to stimulate organizations throughout Europe to engage in improvement activities that should eventually lead to excellence in customer and employee satisfaction and impact on society and business results.

There has also been widespread interest in the practical value of achieving the 'International Standards Organization' (ISO) levels of quality. This is a set of five international standards for quality assurance that have commercial and economic significance for organizations. These standard guidelines help

companies organize their processes by achieving cost effective quality assurance methods.

Six Sigma developed by Motorola in the 1980s and with its roots in Statistical Process Control (SPC), is fast becoming a proven approach for businesses and organizations to improve their quality. In statistical terms, the purpose of Six Sigma is to lessen process variation so that virtually all products or services are provided to meet or exceed customer expectations. The three basic elements to Six Sigma are process improvement; process design/redesign and process management.

These models provide a recognized approach for evaluating organizational performance and comparing them to other organizations. However self-assessment does not lead to the adoption of best practices nor ultimately create significant quality improvement. To achieve notable performance improvements as assessed against these models, it is necessary for organizations to have an external focus and a committed attitude, to continually search for better practices with the objective of adopting them.

2.3. Training

One of the basic principles of quality is accountability by the person performing the work. IS professionals are typically charged with managing the enterprise's information resources, yet few receive formal training for improving IQ. However, to hold information producers accountable they must be trained (Lee & Gharajedaghi 1998; Beckford 2005). Increased reliance on teamwork highlights the importance of training in adapting to changing work environments. During the last decade there has been tremendous growth in training research with many theories, theoretical frameworks, ideas and constructs on training than ever before (table 2-10). Although training is critical

for an organisation's quality improvement efforts to achieve their goals, assigning money and resources to improve employees' performance is not only costly and time-consuming but often disruptive for workflow.

Table 2-10 Training Factors and Theories

	Training Design & Delivery	Conscientiousness & Training	Training Transfer	Measurement	Opportunity to Perform	Transfer Climate
Cannon Bowers et al. (1995)	●					
Cannon Bowers & Salas (1997)				●		
Kozlowski & Salas (1997)			●			
Kozlowski et al. (2000)	●		●			
Kraiger et al. (1993)				●		
Ford et al. (1997)					●	
Thayer& Teachout (1995)						●
Colquitte & Simmering (1998)		●				
Martocchio & Judge (1997)		●				

The American Society for Training and Development (2008), shows that U.S. organizations spent $134.39 billion yearly on employee training. Despite what would appear to be adequate training dollars spent, the degree of change in performance due to training does not always meet management expectations (Bassi 2000).

Training professionals need to show the value of their training programs: the effectiveness of the training and whether or not training is producing the desired outcome. A review of the literature suggests that human resource

management practices are the most powerful predictor of improvements in the companies' productivity and profitability. Practitioners signalled that the goal of training is immediate improvement in performance of skills in the workplace (Schmidt & Bjork 1992; Broad & Newstrom 1992). Yet, only 10 percent of training outlays result in the transfer of learned skills and knowledge to the job (Baldwin & Ford 1988; Smith-Jentsch et al.2001).

The challenge for organisations already aware of quality improvement lies in their unfamiliarity with the amount of training needed to support the implementation of an effective quality improvement strategy (Johnson 1993). Lack of suitable training has been known to lead to negative outcomes and some organisations failed their quality initiatives (Chang 1993). Many obstacles impede the effectiveness of training such as improper needs assessment, unskilled trainers, and poor training techniques (McCahon et al.1996). Organisations have often rushed into training programs without thoughtful needs assessments (Johnson 1993). Excessively ambitious quality directors sometimes implemented unnecessary training programs (Chang 1993). Therefore, to ensure positive training results, organisations need to complete a number of necessary phases for training: needs assessment; development and evaluation (Goldstein 1993). Wang & Lee (2001), draws attention to the need to include training on assessment techniques. Training ensures the IQ team have the knowledge and skills needed to carry out their tasks to ensure alignment of processes.

The importance of training effectiveness is recognised as an important issue for organizations (Noe 1986; Ford & Weissbein 1997). There is some research on the area of transfer of training (Ford & Weissbein 1997). This body of knowledge suggests many important factors: the organizational learning environment (Tannenbaum 1997) the transfer climate, which impacts on the extent to which gained skills are used on-the-job (Thayer & Teachout 1995)

time between training intervals and use (Arthur et al. 1998), and peer and supervisor support that plays a central role in skills transfer to the workplace (Tracey et al. 1995; Facteau 1995). Baldwin & Ford (1988), conceptualized the transfer of training as the extent to which skills and knowledge gained in a training program are applied and preserved over time in the job environment. Goldstein & Dillon (1997) states that the greatest challenge is designing, developing, and testing assessments of training and performance. Broad & Newstom (1992), surveyed 85 trainees on how much of the material learned in training was used on the job over time. Immediate use was 41 percent, six months later 24 percent and one year later 15 percent. When conducting an evaluation of a training program managers need to consider several factors that influence transfer (Baldwin & Ford 1988). It is believed that characteristics and the work environment have direct relationships with learning as well as with generalization and maintenance (Yamnill & McLean 2001). Noe & Colquitt (2002) expanded Baldwin and Ford's model to include assessing the transfer climate as an important factor of the work environment. Supervisor support has been identified in the literature as a critical work environment factor influencing transfer (Baldwin & Ford 1988).

Many authors have tried to optimize training through development of theoretical models and examining the impact of training variables such as trainee characteristics, training design, and work environment factors on the transfer process (Baldwin & Ford 1988; Thayer & Teachout 1995; Holton 1996).

Kirkpatrick's levels of training evaluation initially proposed in the 1950's dominated the field of training evaluation for many years (Kirkpatrick 1998). This is an outcome based model defined by four levels: reaction, learning, behaviour and results which organisations use to measure training programs (table 2-11).

Level 1: Trainees' reactions: measures participants' satisfaction with content, process and the training event. Kirkpatrick (1998) provided guidelines for evaluation of reaction that include designing a form that facilitates quantifying trainee reaction by gathering suggestions and feedback that measure reaction against standards.

Level 2: Learning: measures the extent to which participants gain knowledge and skills from the training program. The guideline suggests the use of control groups to measure level of knowledge before and after training.

Level 3: Behaviour change: measures changes in attitudes and/or skills improvement and is the stage of evaluation that decides the extent to which trainees generalize training to the workplace given the appropriate climate. The suggested guideline uses surveys and interviewing to capture the evaluation criteria.

Level 4: Improvements in tangible organizational outcomes measure results revealed in change by improved quality and higher profits. The guideline to evaluate this level is the use of a control group to eliminate factors other than training for observed changes. Kirkpatrick (1998), defined evaluation in two ways: 1) measuring changes in behaviour that results from training and 2) assessing the overall results of the training program.

Table 2-11 Kirpatrick's Evaluation Model

Level	Evaluation Type	Evaluation Characteristics	Evaluation Tools & Methods	Relevance & Practicability
1	Reaction	How the delegates felt about the training experience.	Feedback forms. Verbal reaction, post-training surveys or questionnaires.	Quick and easy to obtain. Not expensive to gather or analyse.
2	Learning	Measurement of the increase in knowledge - before and after training.	Assessments before and after training. Interview / or observation.	Relatively simple to set up; clear-cut for quantifiable skills. Less easy for complex learning.
3	Behaviour	Extent of applied learning on-the-job	Observation and interview over time to assess change, relevance and sustainability of change.	Measurement of behaviour change needs cooperation and skill of line-managers.
4	Results	Effect on business	Measures are already in place via normal management systems and reporting - the challenge is to relate to the trainee.	Process must attribute clear accountabilities.

Baldwin & Ford (1988) proposed a transfer model that highlights the importance of three types of influences on transfer: trainee characteristics: training design and features of the work environment such as peer and supervisors support (Baldwin & Ford 1988). The literature suggests that Baldwin and Ford's transfer model has probably been the most influential on transfer research (figure 2.7).

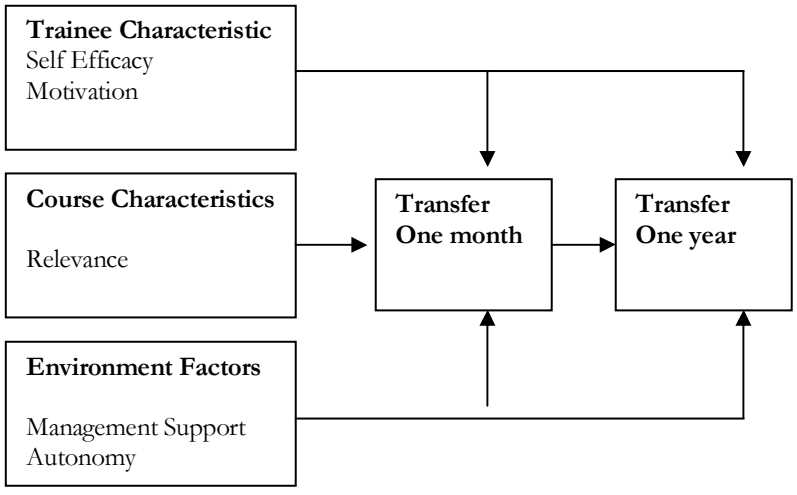


Figure 2-7 Baldwin and Ford Model of Training Transfer

Many factors identified as important predictors of training effectiveness can be classified under Baldwin and Ford's three categories. These factors include self-efficacy as an important trainee characteristic, and supervisor support as an important aspect of the work environment (Baldwin & Ford 1988; Ford, et al. 1992). Ford & Weissbein (1997) invoked 'the opportunity to perform' construct as a way to understand the transfer of training process.

Holton (1996) suggested a framework that included three primary outcomes of training: individual learning; individual performance and organizational results influenced by a combination of motivational, environmental and enabling factors. Their Results Assessment System (RAS) is intended to provide a measurable means for discovering if the desired outputs have been achieved. The parts of RAS are:

1. Process: indicates the general steps necessary to conduct result assessment.

2. Domains: identifies the metrics of outcomes that should be assessed.

3. Plan: defining the decisions necessary to design a results assessment.

4. Tools: how are the results measured and what instruments will be suitable for measuring outcomes.

The outcome of individual learning is influenced by a trainee's motivation to learn, trainee's reaction to training climate and trainee's experience and ability; the outcome of individual performance (after training) is influenced by the trainees' motivation for transfer, transfer climate and the design of training program; and the organizational results are determined by the utility of training and the external events that constrain productivity (figure 2-8).

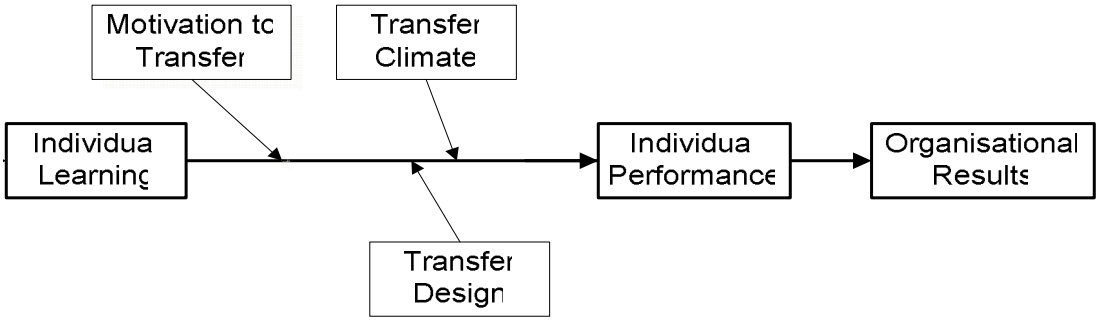


Figure 2-8 Holton's Factors Affecting Transfer of Training

There is a growing body of evidence that personality measures are significantly related to successful job performance (Hogan & Ones 1997). Thus an interest in personality traits has increased in the training literature in recent years (Noe 1986; Colquitt et al. 2000). Many studies have found that personality can be a predictor of work performance (Barrick & Mount 1991; Mount & Barrick 1998). Consensus is emerging that a five-factor model (FFM), often termed the 'Big Five' (Goldberg 1990), can be used to describe the many salient aspects of personality.

2.4. Influence of Personality

According to the FFM, there are five broad categories in the personality trait hierarchy: neuroticism-emotional stability, extraversion, openness to experience, agreeableness, and conscientiousness (Costa & McCrae 1992). Almost all personality tests existing today measure one or more of the five factors depicted in table 2-12. However**,** *Conscientiousness* has been linked to achievement and to the will to achieve.

Table 2-12 Personality Dimensions Costa & McCrae (1992)

Personality dimension	High level	Low level
Neuroticism	sensitive, nervous	secure, confident
Extraversion	outgoing, energetic	shy, withdrawn
Openness to experience	inventive, curious	cautious, conservative
Agreeableness	friendly, compassionate	competitive, outspoken
Conscientiousness	efficient, organized	easy-going, careless

Research supports a relationship between personality and job performance (Barrick & Mount 1991; Costa & McCrae 1995; Colquitt & Simmering 1998; Barrick et al. 1998). Among those traits, conscientiousness (Costa & McCrae 1992) is considered to be especially promising in predicting training proficiency (Hogan & Ones 1997). The more conscientious a person is the more competent, dutiful, orderly, responsible and thorough they are (Costa & McCrae 1992). Training literature suggests that conscientiousness is positively related to self-efficacy (Colquitt et al.2000) and self-deception (Barrick & Mount 1996; Martocchio & Judge 1997). Self-efficacy is positively associated with work-related performance (Hartline & Ferrell 1996). Martocchio & Judge (1997), provided a framework to potentially explain the relationship between conscientiousness and learning. They presented a dual mediating model, whereby both self-efficacy and self-deception mediate the relationship between conscientiousness and learning but in opposite directions. Self-efficacy is expected to have a positive effect on learning, whereas self-deception is expected to have a negative effect on it. According to Bandura (1986) self-efficacy refers to an individual's self-perceived ability to achieve certain outcomes. Given the nature of self-efficacy, it is likely that persons high in self-efficacy would experience higher levels of training motivation than those low in self-efficacy. Persons high in self-efficacy are likely to see themselves as capable of meeting the challenge of their present skills provided by training opportunities (Noe 1986; Tannenbaum et al.1991). Thus, persons high in self-

efficacy should be more motivated to engage in training activities than those who are not. Self-deception is a dispositional tendency indicating an unrealistic positive self-image (Sackeim 1983).

In the Martocchio & Judge (1997) study a negative correlation between conscientiousness and learning examined over a relatively short training program (two 4-hr sessions, separated by 1 work day) was noted whereas, the Colquitt & Simmering's (1998) study reported a positive correlation between conscientiousness and learning, when adopting a relatively longer training program (a 6-week course) was reported.

2.5. Gap in the Literature

It is important that IQM should be tailored to an organization's needs. Even so, little research has been conducted to identify the IQ predictors that should be considered when developing Information Quality Training Plans IQTPs. This thesis aims to address this shortcoming by identifying the predictors most commonly affecting IQ.

While the published academic literature on QM can be traced back to the 1930's (Shewhart 1931), much of the literature of the 1980's and early 1990's is prescriptive. The shortcoming is that the literature simply describes the adoption of quality tools and techniques, rather than the impact on quality performance, and most of the IS research focuses on theoretical modelling of controls and measurement. There is much research on the impact of error in IS (Wand & Weber 1989; Redmond 1998). Other studies focus on editing data and input controls (Garfinkel 1986; Bowen 1993). Clearly much work has been conducted in the IQ literature on IQ and its importance; however, there has been no published work on the key predictors of IQ until the present study.

Given that quality performance is still an important potential source of competitive advantage, firms cannot afford to ignore predictors of poor IQ.

Although many studies in the IQ literature of the late 1990's have addressed the relationship between the various dimensions of quality performance, the omission of training, trainee characteristics, and the work environment as predictors of IQ, posed a significant gap. There has been little understanding from either the theoretical or practical perspective of the relationship between these constructs. This represented a need to empirically measure IQ outcomes based on these selected predictors of IQ to help fill the gap in both theory construction and testing. Conversely, researchers from the training discipline have shared a common interest in examining the effect of influencing factors such as employee personality, work environment and training on transfer of skills to the workplace. Nevertheless, no attempt has been made to apply these predictor variables to IQ.

The influencing factors on training in general can be grouped into two main categories: individual characteristics and organizational factors. Organizational factors have been studied in IQ research, whereas others have been investigated mainly in management training research. Individual characteristics have long been found influential on training effectiveness. Some factors such as conscientiousness, experience, the work environment, and training effects have not been studied in IQ discipline. Therefore, their impact on IQ in particular is still unknown.

Despite persuasive evidence that IQ problems in healthcare lead to loss of human life, decreased quality of life and accounts for substantial economic losses, the literature have to this point, been devoid of conceptual models or systematic investigation of predictors of IQ. Therefore, this research was undertaken, to fill this void by presenting a model of IQ predictors in this

context. It also provides an empirical analysis of the ability to predict IQ outcomes based on these predictors. The research finding based on the model addresses this drawback by identifying the factors which most commonly predict IQ. Moreover, there are to date no guidelines for developing individualised tailored Information Quality Training Plans, IQTPs. This study demonstrates that quality can be improved by including training in IQ importance and awareness, trainee characteristics, and work environment factors in the planning and development of training programs.

2.6. Summary

Providing effective healthcare to patients involves teams of healthcare providers interacting and delivering care to achieve a desired outcome (Hall et al. 2005). IQ is a serious problem and healthcare organisations are no exception (Wang et al.1995). The quality of the healthcare depends on how well the team members communicate, coordinate care, and negotiate their interdependency in practice, in order to achieve a cohesive treatment plan for patients (Hall et al. 2005).

Although companies continue to spend large amounts of time and money on improving employees' performance, they need to demonstrate sustainable methods to justify the value of training programs. Many organizations evaluate the effectiveness of training by measuring the participants' reaction, but few organizations measure whether skills are transferred to the work environment (Kraiger et al. 2004). Training effectiveness can, in part, be determined by examining the transfer of learning to the work place (Noe 1986; Kirkpatrick 1998). Since Kirkpatrick's evaluation levels (reaction, learning, behaviour and results) were first introduced in 1959, evaluations of transfer of learning have included examining the characteristics of training programs and individual trainees, and then relating these factors to training and job performance (Rollier

1993). A critical issue with any training program is the successful transfer of learning to the work environment. Taking into account the external factors with the traditional measures of training effectiveness, a manager can begin to assess how well a training program is performing and determine what changes would make it more effective

This chapter reveals that training research has focused on the role of the training design, environmental factors and trainee characteristics in a training context. Even if a training objective is effectively carried out, the overall business objectives may not be (the trainee may have acquired the appropriate skill but the work environment may be counter-productive to practice what was learned). This chapter reviewed the literature related to training by discussing the dominant evaluation models and approaches found in the literature that have contributed to the emergence of the transfer of training concept. Kirkpatrick (1994) developed a well-known and widely used four-level training evaluation model. Baldwin & Ford (1988) built a model of training transfer. Holton III (1996) produced an enhanced three-level training evaluation model. Though these models provide invaluable insight on training, they do not consider IQ related characteristics such as accuracy, consistency and completeness. It is essential, therefore, to develop a comprehensive model of IQ predictors in its own right to aid in a problem based solution. In Chapter 3 an outline of two paradigms Behavioural Science (BS), Design Science (DS) is provided and a general overview of the chosen research approach for conducting this study is presented.

*C*h a p t e r 3

METHODOLOGY

3.1. Introduction

Chapter 2 provided a review of related work in the IQ and training literatures. In order to realize the goals for this chapter, an outline of two paradigms (a set of beliefs shared by scientists) that characterizes much of research is briefly described: 1) Behavioural Science (BS), and 2) Design Science (DS). A general overview of DS, the chosen research approach for conducting this study, is then presented in section 3-2. The philosophical stance and epistemological underpinnings are presented in section 3-3. Section 3-4 introduces the research framework. Ethical considerations are dealt with in section 3-5, and a brief summary of the chapter is given in section 3-6.

With an ever increasing number of ways to conceptualize and conduct research, there is a greater duty on researchers to be knowledgeable about suitable scientific paradigms within the context of research in general (Easterby-Smith et al. 1997). Real world problems must be properly conceptualized and represented, and techniques for their solution constructed, implemented and evaluated. According to Hevner et al. (2004), two paradigms characterize much of research in the Information System (IS) discipline: BS, which has its roots in social science research methods and tries to understand reality (March & Smith 1995) and DS, a technology oriented paradigm which has its roots in engineering disciplines and tries to create things that meet desired goals.

Theory and theorising plays a key role in BS. BS develops, justifies, and verifies theories, using the application of existing knowledge to organizational problems. Therefore BS tries to describe, predict or explain how phenomena behaves and interacts with each other, and seek to find 'what is true'. Due to their belief in the complex and subjective nature of social reality the methods used vary from positivist through interpretivist. In contrast, DS is a body of knowledge about artificial (man made) objects and phenomena designed to meet certain desired goals and it seeks to create 'what is effective' (figure 3-1). This is achieved by 1) creating innovations, aimed at utility (results) that may be in the form of constructs, methods, models or instantiations, and 2) research activities, comprised of building, evaluating, theorizing about, and justifying artefacts (March & Smith 1995).

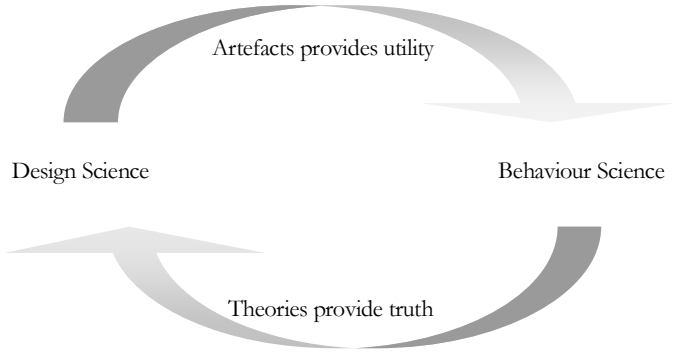


Figure 3-1 Design Science and Behavioural Science

According to many authors DS research is an inventive, or creative problem solving activity to increase the relevance of IS research in which new technologies are the primary products (Nunamaker, et al. 1991; March & Smith 1995; Rossi & Sein 2003; Hevner et al. 2004). The reasoning behind DS is not to understand the phenomena; rather, it is a problem-solution seeking approach, addressing important unsolved problems in unique or innovative ways, or solved problems in more effective or efficient ways, with the intention

of improving their functional performance. The DS goal is to use analytical, quantitative or qualitative models derived from diverse disciplines and link them in a rigorous framework. The design of an artifact, its specification, and the assessment of its utility are integral to DS research. These must be combined with behavioural and organizational theories to develop an understanding of business problems, contexts, solutions, and evaluation approaches.

3.2. Research Paradigm for this Study

While information systems (IS) research has been conducted for many years and traditional research methods are well established, the application of just one research method is not sufficient to obtain viable results in design science considering the rigour and relevance criteria as the main requirements of design science (Hevner et al. 2004). Traditional research often focuses on theory building and theory testing. In an Academy of Management review, Whetten (1989) defined a framework of what constitutes a 'theoretical contribution'. Central to his framework and to theory building is the notion of 'understanding the ''why'' of a phenomenon in question to help discern how things function and come to be as they are'. The nature of this current research is not the understanding of a phenomenon but is rather a problem-solution finding approach. It is mainly about investigating key predictors of, and their relationships to, IQ, in order to provide a problem solution.

Some important questions that no doubt immediately follow are: 1) what is the most valid and viable research approach for this study as it neither contributes to theory building as previously defined nor to theory testing 2) what constitutes as being scientific and 3) can a problem-solution finding approach qualify as scientific specifically in IS.

Nunamaker et al. (1990) classify DS in IS as applied research that applies knowledge to solve practical problems. Kuhn (1970) states that scientific research paradigms are a collection of beliefs shared by scientists; a set of agreements about how problems are to be understood. Therefore to ensure that this research qualifies as scientific, an

accepted problem-solution finding scientific research method applied to IS called DS (March & Smith 1995; Au 2001; Ball 2001) method was identified as the most appropriate approach for this study. This methodology of DS can be traced back to the work of Brown (1992) and Collins (1992). Therefore, DS is not a research method on its own, but a formalised combination of existing methods with the intent of producing new theories, artefacts, and practices that can be used to account for the impact of training trainee characteristics, training design, IQ perception, the work environment and work experience on IQ. Figure 3-2 shows the specific DS guidelines as applied to this study to produce a valid and viable research approach.

Design Science Circles Adapted from Hevner et al., (2004)

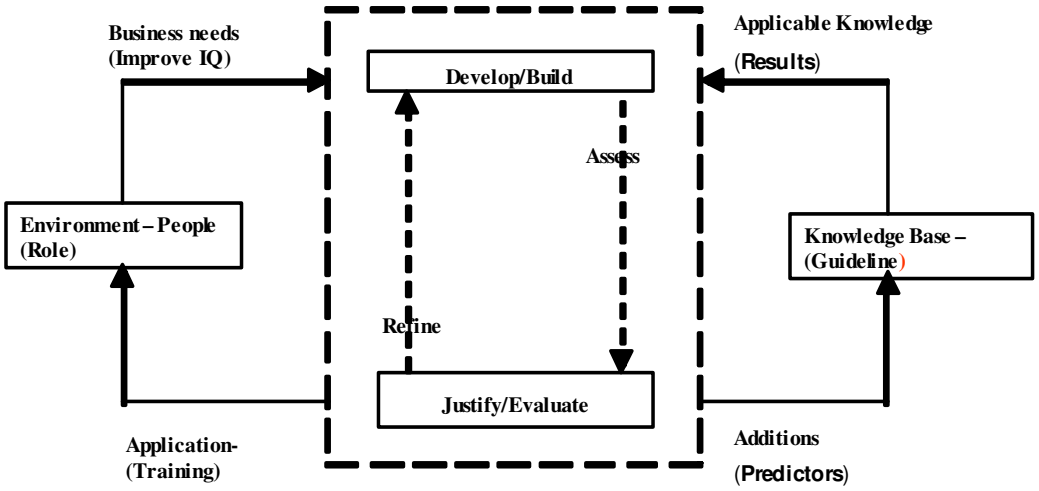


Figure 3-2 Design Science Methodology Approach to Study

March & Smith (1995) in a widely cited paper propose a four by four framework that produces sixteen cells under two axes: research activities; build, evaluate, theorise and justify, and four outputs: *constructs*, *models*, *methods,* and

instantiations (table 3-1) for describing a viable DS research effort. A research effort can cover multiple cells but not necessarily all of them.

- Constructs arise during the conceptualization of the problem and form the problem/solution domain.
- Models are a set of statements expressing relationships among constructs.
- Methods are a goal directed set of steps (algorithm or guideline) for manipulating constructs so that the solution statement model is realized.
- Instantiation is the realization of the artefact by operationalizing constructs, models, and methods in an environment.

Table 3-1 Business Ontology – A DS Approach (March & Smith 1995)

		RESEARCH ACTIVITIES			
		Build	**Evaluate**	**Theorise**	**Justify**
Research Outputs	**Construct**	Predictors of IQ	Experiment & Survey		Interviews
	Model	IQ Predictor Model	Experiment & Survey	IQ Predictors	Statistics
	Method				
	Instantiation	Experiment & Survey	Statistics		Interviews

3.3. Philosophical Stance

By definition DS introduces novel artefacts with intended problem solving functionality. Following the DS activities described in section 3-2, the objective of this dissertation is to solve IQ problems by introducing into the environment new design artefacts, the availability of which will cause employees to abandon their previous problem producing behaviours. The purpose of using DS research is the building of artefacts to address an important and relevant environmental organisational problem. This was achieved as follows; 1) the designing and building of a situational representation in the form of a predictor model that help identify predictors of IQ. The constructs identified in the model

represented a real world situation, highlighted the problem, aided in problem and solution understanding and thereby, suggested the solution space that enabled exploration of the utility of the Information Quality Training Requirements Analysis Guideline (IQTRAG) based solution; 2) by designing and building a generic abstract level IQTRAG, a set of steps in performing the task of developing an effective and usable Information Quality Training Plan (IQTP), and 3) by evaluation of the IQ predictor model using a controlled experiment, group discussions and a Web based survey. The results of this thesis add to the knowledge goals of the scientific community by providing valuable and valid input for the scientific knowledge base as well as providing a solution to a practical, costly and topical IQ problem in organisations.

A quantitative and qualitative approach was recognised as the most useful as it helped prevent bias in the gathering and presenting of research data. The nature and definition of IQ as seen from the literature review in Chapter 2, creates epistemological assumptions that IQ is a subjective term and can only be measured from an individual perspective. The use of experimental information collection avoided subjectivity by objectively collecting information. In addition, the IQ literature typifies the notion that multiple assumptions can and do survive side by side and a wide variety of approaches has been used depending on the research proposition under investigation. This allows the flexibility to select multiple paradigms and methodologies from within different approaches and according to the DS Guidelines, table 3-2 is often found to be more valuable.

3.4. Research Framework

Existing research provides several models to aid in the integration management of IQ, but so far there has been little empirical or systematic investigation into influencing factors of IQ to identify predictors and

subsequently the root cause of poor IQ. Accordingly, the aim of this study is to address this issue. First a review of the QM, TQM, IQM, training, KM and IS literature was undertaken and the omission of training, trainee characteristics, and the work environment as predictor variables on IQ was noted from these literatures. Finally the development and testing of a proposed model of predictor variables was undertaken.

First, a triangulation research framework is presented. From the DS perspective a guideline for IQTRA to aid in the development of effective IQTPs is provided. Requirement training analyses are contextualised within the healthcare setting as a means to provide an assessment of IQ training requirements. A Web based survey is used as a theoretical foundation to integrate BS into the DS process of including training design, duration, intervals and other predictor variables to the context. This study presents a two dimensional framework for research in IQM. The first dimension is based on two research activities: 1) build and 2) evaluate. The second dimension is based on two outputs: 1) constructs and 2) model. This study essentially covers 'build' and 'evaluate' research activities and a research output of 'construct and 'model'. The first research goal of this study is to build an ontology (artefact or model) that makes it possible to conceptually express the logic of this study in a structured form. The second research goal consists of applying this model to one of its possible uses (instantiation). Firstly, the instantiation of the ontology in a nursing school environment at DCU, that allows capture of the impact of training in a structured way and secondly, in a Web based survey using Survey Monkey administered to a population of practising professionals.

In terms of March and Smith's research framework this means aiming to find the basic constructs of a model and building an ontology that expresses the relationships among them. Subsequently, evaluation of the constructs and the

model, based on an adequate measurement system, was undertaken. The research design was divided into two major sections: experimental design and survey design. Experimental design concentrates on the procedure of the experimental task. The survey design is to develop an instrument for validating IQ predictors. This study adhered closely DS guidelines; see figure 3-3 and the rigour of the research is shown on table 3-2.

Table 3-2 Rigour of the Research

DESIGN	CONTRIBUTION	GUIDELINE
Grounded In	Data Quality Foundations (Wang et al. 1997)	Research Rigor
Performed in two phases	1) Experimental research of student nurses 2) Survey Groups of Medical Practitioners	Design Evaluation
Design as	1) Model of predictor variable 2) IQTRAG	Artifact

To begin, the exact problem to be addressed was selected and phrased to select the correct design, methods and evaluation techniques. The first problem, hypothesis H1 was to investigate the effects of training in selected IQ dimensions on IQ. To explore this relationship IQ should be measured before and after training. Based on the above hypothesis the following three questions needed to be answered: 1) what are the most important IQ dimensions for assessment and evaluation in the context of this study? 2) How can an objective assessment of pre training and post training be effectively carried out? 3) How can the effects of various other influencing factors be ruled out? From reviewing the IQ literature an objective metric for measuring IQ dimensions was selected (section 2-2-3). Furthermore, reviewing the various research designs, it was noted that experimental research can typically enable controls over various important factors and systematically and convincingly 'rule out' other possible explanations for improvement in a cause and effect relationship. By definition, experimental design can be called a 'blueprint' of

the procedures that enable testing hypothesis in reaching valid conclusions about relationships between training and IQ, and, for this reason, a laboratory experiment was designed. The next step was to investigate important predictors of IQ. Group discussions and face to face interviews were insightful in identifying predictors other than training and invaluable as a means of supporting the proposed IQ model. To develop the model the relevant literatures were searched 1) for the most common training models (section 2-3) and 2) for an instrument to measure trainee characteristics (section 2-4). The developed model consisted of three main predictor categories.

Therefore, to gather the appropriate information to answer the research questions in the most fitting way a mixed methodology approach (triangulation) was used in which quantitative methods were supported by qualitative research methodologies. Initially, an objective measurement method was used, to gather data on information recording quality, before and after training. Subsequently, in conjunction with the experiment, a survey with subjective measurements was administered, to gather data about the present existing condition of IQ in the healthcare domain and to determine predictors of IQ. The impact factor of each construct was part of the objective. In the survey no manipulation of the research environment was necessary and rather than employ various research controls such as in the experimental approach, the survey data gathering method centred on understanding the phenomena in their naturally occurring states. In parallel to the quantitative method used for the survey and experiment, a qualitative approach, group discussions and patient interviews, was utilised to produce verbal information rather than numerical values. One notable strength of conducting group discussions and interviews is that it generates a truer feeling of the research setting, which cannot be obtained from statistical analysis and numerical data used throughout the survey and experiment. This method allowed flexibility in the data gathering and aided in the analysis and interpretation of the data gathered in the survey and the

experiment. A roadmap to the DS guideline according to this study is given in figure 3-3.

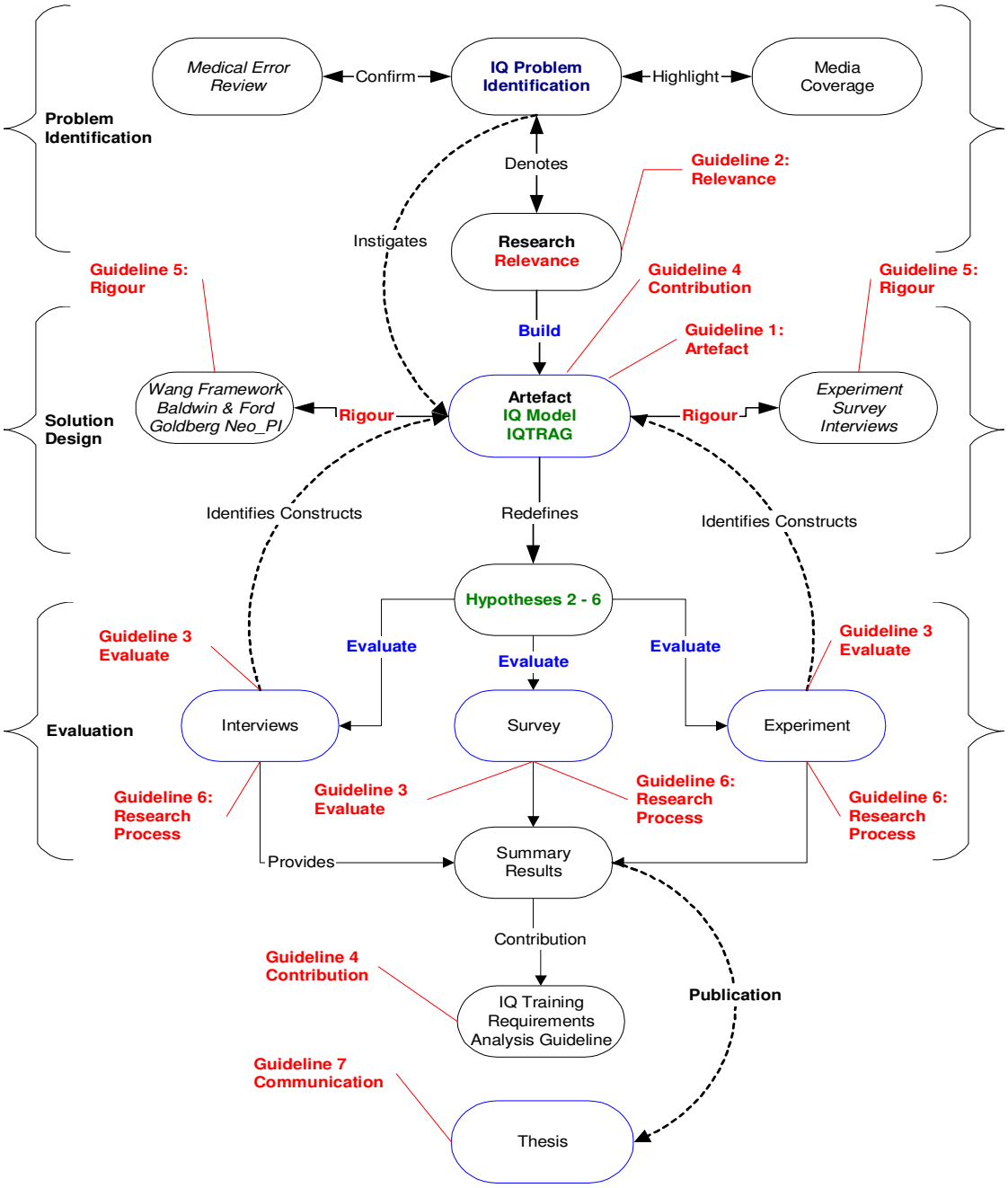


Figure 3-3 Design Science Guideline Map to this Study

To recap, three types of data were gathered: 1) experiment with objective measurements; 2) survey with subjective measurements, and 3) group discussions and interviews to support and corroborate results from the survey, and experiment and validate the conceptual model and IQTRAG.

Guideline 1 Design as an Artifact: This was achieved by the design and development of an information quality training requirements analysis guideline (Chapter 6) and the development of the IQ predictor model. Guideline 2 Problem Relevance can be seen from the many studies done on medical errors with rising costs due in part to poor IQ detailed in Chapter 1. Guideline 3 Design Evaluation: The research was evaluated by a mixed method approach which included an experiment to examine the impact of training, a Web based survey to investigate predictor variables and their impact on IQ and interviews. Guideline 4 Research Contributions: This research approach introduces new concepts, constructs and their relationship to IQ within a predictor IQ model and an output of an information quality training requirements analysis guideline as a problem solution. Guideline 5 Research Rigour: This research is supported by statistical analysis, existing evaluation methods, models and measurements, and grounded in existing research using a modified version of Wang and Strong' IQ Framework, Goldberg's FFM and Baldwin and Ford's Transfer of training model. Guideline 6 Design as a Search Process: Solution divided into process steps and the most suitable instruments designed in each step (survey, experiment or interviews). Guideline 7 Research Communication: The knowledge gained in this study shall be communicated to the wider audience by the publication of the thesis, presented at international conferences, and published in international journals.

One challenge of doing IQ research on a DS approach is that although DS has the potential to offer a useful methodological toolkit the question that must be addressed if this approach is deemed credible and trustworthy to others is

'What delineates DS from other forms of research?' Therefore it is important to clarify the distinction between existing methods and those central to DS. DS focuses on understanding the complexity of real-world practice. Further, DS involves flexible design revision, multiple dependent variables and capturing social interaction. Lastly, given the focus on characterizing situations as opposed to controlling variables, the focus of DS may be on developing a profile or theory that characterizes the design in practice as opposed to simply testing hypotheses. DS research requires more than understanding outcomes in one particular context, but also requires showing the relevance of the findings derived from this context to other contexts.

DS resembles formative evaluation methodologies as both are process-oriented, iterative, and involve creating a tangible design that works in complex social settings. Fundamentally, formative evaluation methodologies are about improving the value of a particular designed artefact, whereas DS research is concerned with using design in the service of developing models of how humans think, know, act and learn. A critical component of DS research is that the design is conceived not just to meet local needs, but to advance a theoretical agenda, to uncover, explore, and confirm theoretical relationships. What separates DS research in the sciences from formative evaluation is 1) a constant impulse toward connecting design interventions with existing theory, 2) DS research may generate new theories and not simply testing existing theories, and 3) that for some research propositions the context in which the DS research is being carried out is the *minimal ontology* for which the variables can be adequately investigated (we cannot return to the laboratory to further test the theoretical claims). DS research requires more than simply showing how a particular design works. It demands that it generates evidence-based claims that address contemporary theoretical issues and further the theoretical knowledge of the field.

3.5. Ethical Considerations

As this study required the participation of human respondents, certain ethical issues were addressed. The consideration of these issues was necessary for ensuring the privacy as well as the safety of the participants. Moreover, ethical standards require that subjects not be compelled into taking part in the research. Therefore, official ethics approval was sought and obtained, from the Dublin City University Ethics Committee.

Ethical issues considered in the research process included consent and confidentiality. Subjects were assured that the only records kept by the experimenter were the random numbers on the task form, which did not relate to their names. Subjects were also assured that their identities would remain unknown to everyone, including the experimenter. Participants' confidentiality was guaranteed to be protected and identifying information would not be made available to anyone, even those directly involved in the study. Only relevant details that helped in answering the research propositions were included. Data was reported in a way that would not reveal the identity of the individuals. ID codes were used in a way that only the students would know their own number. The anonymity and confidentiality of participation was fully protected. However, these measures can only guarantee confidentiality within the limits of the law. The results of this study were reported as group data only. Individual information is not identifiable in the report.

To secure the consent of selected participants, the researcher relayed all-important details of the study, including its aim and purpose. A plain language statement (Appendix F) on the voluntary nature of the experiment was provided. By explaining these important details the participants were able to understand the importance of their role in the experiment. The participants were advised that they could withdraw from the study at any time during the

process. They were not forced to engage in the research. The voluntary participation of individuals in the research, which was based on a full understanding of its possible benefits and risks, was provided. Informed consent forms were signed by the participants when they agreed to the contents and volunteered to engage in the study (Appendix G).

Approval was sought and obtained from the management of School of Nursing, Dublin City University, Ireland, to undertake the research within their Nursing School; to invite 3rd year nursing students as possible research participants, and to gain exclusive use of the Dublin City University School of Nursing, CHASETown, virtual hospital and classroom resources for experiment and training purposes.

Control group participants were asked to participate in the skills based task and document all relevant information. The total time commitment required of them did not exceed 2 hours. However, the experimental participants were asked to contribute in two ways: 1) to attend the training workshop where they would be briefed in IQ, and 2) to participate in the skills based task and document all relevant information so that documentation quality after training could be evaluated. The total time commitment required of the experimental group did not exceed 3 hours. Documented data was collected individually and aggregated by the investigator.

3.6. Summary

The study suggests that the impact of high-quality healthcare documentation should be assessed on several levels: the quality of information recording; training sequencing; training duration; the work environment; team support; IS and personality traits. Therefore, the survey methodology was used to further explore these constructs and to discover their impact on IQ. The dimensions

chosen to be assessed were selected from the established IQ literature. The study adopted the ideas of Ballou & Pazer (1985) using three of the suggested four most important dimensions of IQ: accuracy, completeness, and consistency from the IQ framework of Wang & Strong (1996). The literature also provided a set of metrics for measuring IQ. Interviews with medical professionals confirmed the importance and relevance of the selected dimensions under investigation. Chapter 4 presents an analysis of the data collected in the experiment and in Chapter 5, the survey phases of the study. Both chapters describe how the data was analysed. Chapter 6 presents the problem based solution, IQTRAG.

C h a p t e r 4

EXPERIMENTAL FRAMEWORK

4.1. Introduction

Chapter 3 argued for the Design Science (DS) research methodology used in this research. The study was carried out in three phases. In phase one, a controlled experiment was conducted, which included group discussions with participants, interviews with patients and observations from two research observers. In phase two, a web based survey was purposefully designed and administered (detailed in Chapter 5) and based on the results 'An Information Quality Training Requirements Analysis Guideline' (IQTRAG) was developed (outlined in Chapter 6) see figure 4-1. This chapter presents the findings from phase one and outlines the experimental setup for data collection together with a description of how the data was analysed.

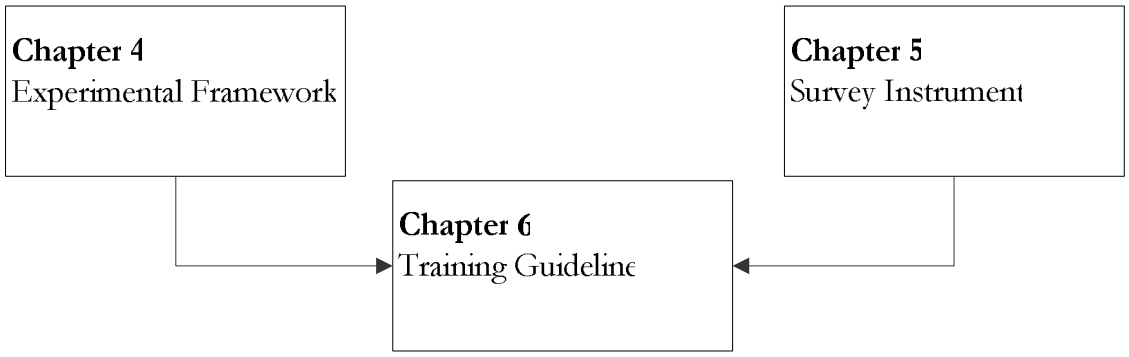


Figure 4-1 Research Data Gathering and Research Output

To investigate the research proposition H1: 'Training will be associated with improved IQ', an experimental research approach was used within a virtual

hospital environment 'context' to collect data to prove or disprove the theory. By the use of experimental techniques and methods, distance was maintained from the research participants and the data was analysed statistically to reach objective facts. However, as the experiment was conducted within a controlled environment, it can not be assumed to be a true mapping of the real world and therefore can at best give a generalization of the gathered data with tentative synthesised interpretations.

4.2. Experimental Design

Experimental design is best suited for assessing the following proposition: If X, then Y; 'if training is given, then IQ improves'. Unfortunately, it is not enough just to show that when training is given IQ improves, as there may be other external factors which may contribute to the noted improvement apart from training. The external factors identified in this research will be investigated in phase two of the study as discussed in Chapter 5. To show there is a causal relationship between training and improved IQ, two propositions needed to be simultaneously addressed: If X, then Y and If *not* X, then *not* Y; 'If training is given, IQ improves and if training is not given, then IQ remains at baseline' (figure 4-1). If these two propositions can be proved, then it is suggestive of the causal effectiveness of training (figure 4-2).

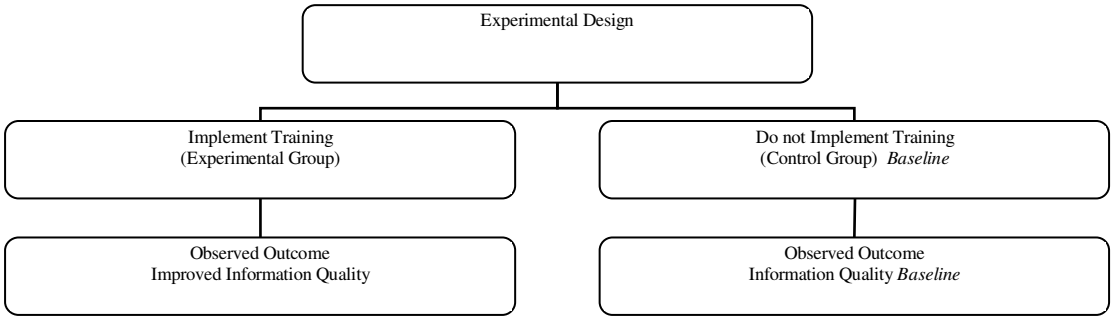


Figure 4-2 Experimental Research

Given the difficulty of maintaining objectivity and claiming with certainty that training alone caused improvement in IQ, a manipulative methodology using experimental design and empirical methods, to reduce the problem of multiple variable interferences was employed. In this way the researcher was able to control the work environment, and thereby neutralize the effects from other factors. This helped to remove bias by discovering objective facts and created the ability to assess the impact of training on IQ. It is expected that training will improve the baseline documentation quality and will show a statistically significant difference in IQ recorded between the experimental and control groups in accuracy, consistency or completeness, or a combination of these dimensions.

4.2.1. Experimental Methodology

The experiment provided a framework for suggesting a relationship between training and improved IQ. This involved manipulating the training variable and noting the outcome on the IQ variable. Ideally, what were needed were identical conditions and the same people to discover if IQ improves following training. Campbell & Stanley (1963) indicate that a dependent variable may be affected by subjects' prior testing (pre-test) experience. Hence, the act of completing a data gathering exercise a second time with the same subjects is likely to affect subject performance or recall (Martella et al. 1999). However, this created a paradoxical situation as training needed to be given and not given to the same group simultaneously. However, this obstacle was overcome by creating two groups that were as similar to each other as possible. Training was not administered to the control group so that a pre-training baseline level of IQ could be observed and training was administered to the experimental group and the level of IQ improvement of baseline level of IQ was observed. Firstly, two groups (that were equivalent to each other) were created. One group (experimental) was trained and the other group (control) was not.

External factors were controlled by using similar people who shared a related background knowledge and education. The two groups were deemed to be as comparable as possible, thus this was arguably the closest method possible to training and not training the same group simultaneously. Subsequently any differences noted in the IQ documentation recorded between these two groups, was due to the only feature that differed between them which was that the experimental group was provided with training and the control group was not.

Effects associated with the subject selection process may influence the independent variable in such a way that associated measurements are unrepresentative of what might be expected (Campbell & Stanley 1963; Nelson et al. 1999). The approach used in this study to select two equivalent groups relied on the technique of randomly assigning subjects into groups from a common pool of people. However, even with random assignment it can never be expected that the two groups created are identical, so the idea was to rely on the notion of probability and assume the two groups were 'probabilistically equivalent' (Cook & Campbell 1979). It is assumed that if there are sufficient people in our study there is a good chance of assessing whether training caused improvement in IQ. It is generally recognized that clinical studies often involve small samples. Kraemer (1981) pointed out that 'a minority of clinical research studies report as many as 30- 40 subjects'. She further noted that 'in recent psychiatric clinical research, 20 seems a generally acceptable sample size' but that 'many studies with fewer than 20 subjects are published' (Kraemer 1981).

Both groups, see section 4-2-2, preformed a series of routine hospital tasks, designed and developed by the researcher with advice from practitioners in the medical field (see Appendix E). The experimental factors, such as the data set, were the same for both groups. There were two experimenters dividing their work at random between experimental and control groups, with both groups

working simultaneously. The IQ improvement was specifically measured, from data collected in the manually filled patient records, recorded in all cases. The experiment was completed, firstly with the control group, and the baseline pre training documentation recording quality accessed. IQ levels were identified by comparing the information recorded in the manually filled patient records to what should have been recorded in accordance with the instruction sheet provided.

As outlined in Chapter 2, section 2-4, notable research supports the relationship between personality and job performance (Barrick & Mount 1991; Costa & McCrae 1995; Colquitt & Simmering 1998; Barrick et al.1998). Therefore, as well as the task based test, a NEO_PI personality questionnaire (Goldberg 1990) (Appendix C), was administered to both groups. This helped to identify nature vs. nurture aspects. Among the personality traits, conscientiousness (Costa & McCrae 1992) was considered to be especially promising in predicting training proficiency (Hogan & Ones 1997). The NEO_PI test covered the conscientiousness trait of personality, which dealt with the constructs of assertiveness, intellect, self-efficacy, orderliness, dutifulness, achievement striving, self-discipline and cautiousness (Goldberg 1990).

4.2.2. Experiment Sampling Frame

To build the sample group selection for this study, certain inclusion criteria were imposed. For the participants to qualify in the sample selection, students had to be in the final year of an undergraduate nursing degree, studying the same modules, and have undergone work experience in a real hospital setting. This qualification ensured that the participants understood the nature of manually recording patient information and its importance in their daily work processes, thus making the task based scenarios easy for them to understand and perform. Thirty eight final year student nurses from Dublin City University

School of Nursing signed the consent forms and were randomly assigned to either the control or experimental group.

Random sampling was conducted whereby each member of a population had an equal opportunity to become part of either group. For this procedure, a lottery type sampling technique was employed. This method involved selecting the groups at random from the sampling frame by using unsystematic numbers. Letter (A) was assigned to the experimental group and letter (B) to the control group. These letters were written on individual pieces of paper which were folded and placed in a box. Each participating nurse in turn, and in random order, drew one letter from the box which assigned them to a particular group. This process was repeated until both groups were filled with 19 subjects assigned to each group. However, on the appointed day of the experiment 23 subjects, fifteen who had been assigned to the control group and eight who had been assigned to the experimental group participated.

4.2.3. Environment

CHASEtown is an open source virtual hospital learning environment in Dublin City University, School of Nursing, Ireland. It focuses on the education and training of healthcare professionals. Practical skills form a large part of the programmes taught to students in the school-based simulated nursing environment to prepare them for their practical experience in the clinical environment. A central part of the School of Nursing strategy is to support all students across the spectrum from novice, full-time undergraduate students, to part-time students who are working full-time as experienced clinicians.

Given that nursing is a practice-focused discipline, the issue of integrating theory and practice is particularly acute. Therefore, CHASEtown was an appropriate setting for this study and extensive use of the CHASEtown virtual

hospital environment was used to simulate activities of a physical hospital environment. This environment was carefully prepared to create the atmosphere of a real hospital setting. The two hospital wards contained 16 hospital beds, manikins, drug trolleys, a nursing station and other relevant equipment that could typically be found in a hospital. Sixteen subjects were invited to role-play as patients.

4.2.4. Experimental Procedure

The procedure used in this experiment involved several steps (table 4-1).

Table 4-1 Experimental Procedure Steps

Steps	Procedures
Step 1	Virtual patients set up with histories and medical records
Step 2	Meetings with members of program board (School of Nursing)
Step 3	The study explained to students to elicit participation
Step 4	A plain language statement administered to participants explaining the study in detail
Step 5	Consent forms signed by participating subjects
Step 6	The subjects complete a questionnaire
Step 7	Appointments scheduled for experiment
Step 8	Scheduled training session was experimental group
Step 9	Conduct the experiment

Initially eight virtual patients with medical histories were created. This led to the design and development of individual manual patient charts. Each chart had a unique identification (ID) hospital number, past medical histories, and medication regimes. As it was attempted to simulate real-life, a selection of typical practices within a real hospital was created. Nurses attended to

routine nursing activities such as admitting patients, taking and recording vital signs, giving medication and discharging patients. The tasks also dealt with reviewing patient notes and recording interventions and vital signs. The goal based scenario was simulated, in which participants assumed their main role, carried out the tasks associated with the scenarios and documented events. Following this, the experiment research design and the aim of the experiment was discussed at length with the course co-ordinator and two staff members in the School of Nursing, Dublin City University, Ireland. Approval was sought to elicit students as voluntary participants in the study and permission obtained to carry out the experiment within the virtual hospital environment.

Next, students were then introduced to the study in a 30-minute introductory session, which outlined the overall aim of the research. This allowed students the opportunity to engage in a class discussion about their role in the study. All students received a plain language statement as part of the ethical procedure (Appendix F) and 38 students, who agreed to voluntarily participate, signed the informed consent form (Appendix G). Students with any concerns about the exercise were invited to speak to the investigator. Following this the participants were divided into two groups. Nineteen were assigned to group A (control group) which were expected to participate for two hours and 19 assigned to group B (experimental group). Subjects in this group were expected to participate for 3 hours as described above.

Data collection began with a NEO_PI personality test administered to the entire population (Appendix C). This included an IQ perception questionnaire to access a baseline of participants' IQ awareness and IQ recording experience, as well as demographic information.

The control group arrived at the specified ward on the 17th November 2008 and received instruction (Appendix B). Each student was given a unique ID number

and assigned a task packet. The ID number was used as a control number and as an indicator to assign the student to either ward 1 or ward 2. The data was collected through manually filled patient records (Appendix D) on given scenarios (Appendix E). The scenarios were introduced as a 'fact sheet', which gave the background history of the patient and the intervention to be administered and recorded. Each nurse filled individual sets of patient records. At the end of the two hour session, nurses were expected to have recorded all relevant data into the manual patient charts. Each participant received an individual set of patient records with both the participants' and patients' unique ID numbers firmly attached to the workbook.

The experimental group arrived for training on November 24th 2008 and received a training workshop. This training was an intensive one hour session designed for people who were to partake in the next stages of the experiment and had not been exposed to previous IQ training. Total participation was limited to no more than 20 people and was designed for group participation. The training was carried out in a computer laboratory in Dublin City University, School of Nursing. A PowerPoint projector and large screen was set up at the front of the laboratory. Participants were asked to partake in the discussion on the importance of the workshop content and their perception of IQ in general. Advance reading was not required. A set of patient record handout material needed for this training was provided to each participant, together with a copy of the PowerPoint training presentation. The goal of the training session was to provide participants with an opportunity to better understand the concepts of IQ, with a view to improving baseline IQ recording. The session began with:

1. An introduction to data management (DM) (5 minutes).
2. An Introduction to Information Quality (IQ) and why IQ is important (10 minutes).

3. A discussion of why accurate consistent and completeness of information recording is important in general and in healthcare. This led to a further discussion on medical errors (15 minutes).
4. A discussion on reasons for recording good quality documentation covering topics of patient care, legal claims and payment justification (10 minutes).
5. Practical sample documentation recording of patient admission, medication regime and discharge (10 minutes)
6. Questions and Answers and wrap up (10 minutes).

On completion of the workshop participants immediately underwent the same experimental documentation recording process as the control group.

4.2.5. IQ Measurement

Two types of variables were identified: dependent variables, that measures various dimensions of IQ (accuracy, completeness and consistency), and independent variables that measures training. The IQ dimensions were identified using Wang's framework and the IQA developed by (Lee et al. 2002) and measured using Redman's (1995) metric section 2-2-3. Experimental tasks that measured the dimensions of accuracy, completeness and consistency are listed in Appendix E.

The nature of the hospital environment was understood and analysed through informal interviews with practitioners so important IQ dimensions could be chosen for measurement. The IQ measurement was selected from established measurement techniques in the IQ literature (Redman, 1995) outlined in section 2-2-3. This form of measurement was useful for measuring consistency, accuracy and completeness (table 4-2). When computing data accuracy, the metric is defined as the number of data units accurate divided by the total number of data elements. The total completeness is measured by

taking the ratio of the number of incomplete items to the total number of items. A metric measuring consistency is the ratio of specific consistency type to the total number of consistency items. The research propositions focused mainly on finding relationships between training and accuracy, consistency and completeness of IQ. In the context of this study, quality measure is essentially pieces of data that tell how healthcare processes and interventions are being documented under the selected IQ dimensions of accuracy, consistency and completeness (Wang & Strong 1996). The accuracy measure tells what percentage of the data items were documented in an accurate manner; the consistency measure tells whether the nurses followed the precise representation format specified by the code of practice (dd/mm/yyyy for year and using 24-hour clock to record times e. g. 15:00). Although consistency has two dimensions, structure and content, this study refers only to the structure of the data and not to the content (Ballou & Pazer 2003). The completeness measure reveals if all the data was recorded in a complete manner.

Table 4-2 Information Quality Metrics Classification

DIMENSION	METRIC	DEFINITION AND MEASUREMENT PARAMETERS
Accuracy	# correct values / # total values	The measure or degree of agreement between a data value and the source agreed to be correct
Consistency	# consistency / # total	The extent where the physical instance is in accordance with the specified format
Completeness	# incomplete items / # total items	The extent to which data elements are not missing

4.2.6. Pilot Study

To determine the quality of the experimental design, a pilot study was conducted by administering the instrument to a group of five participants, personally known to the researcher. The participants possessed varying degrees of knowledge about IQ. Feedback obtained from the pilot study

ensured that problems were captured and changes made where required. It used the same basic procedure as was used in the experiment. This produced estimates of the average time to complete the tasks. Pilot participants were also asked to comment on the usability and clarity of the questions, the instrument and the intelligibility and consistency of tasks and procedure. The instrument was then checked against the following:

- The applicability of the selected dimensions
- The language used in the tasks
- The design of the patient records
- The length of time required to complete the assessment.

The subjects in the pilot test also completed the personality test questionnaire. They reported if there were ambiguities in either the task or the questionnaire. The pilot study helped to clarify problems such as time management and as a result, the experiment was reduced in size.

4.3. Experimental Findings

All data were examined and coded into SPSS (Statistical Package for Social Sciences) 15.0 for Windows. A range of data analysis methods were employed on the data. These included participants' demographic information, section 4-3-1; IQ descriptive statistics, section 4-3-2; tests for normal distribution section, 4-3-3; independent sample t-tests of IQ means, section 4-3-4; correlations of participants' IQ perception and IQ recording, section 4-3-5, and the impact of trainee characteristics, section 4-3-6. The values were calculated as the statistical mean of the items associated with each group. Data was evaluated by objective measurements using the simple ratio method as described in section 4-2-5.

The goal for the statistical part of this research is to investigate causality and in particular to draw a conclusion on the effect of changes in the values of the dependant variables. An experimental causal statistical method was used in this research where the effect of the differences by the independent variable (training) on the behaviour of the dependent variable (IQ) was observed. The experimental study involved taking IQ measurements of the sample under study, introduce training, and then take measurements using the same procedure to determine if the training modified the original values of the IQ measurements.

Descriptive statistics were used to summarize the population data by describing what was observed in the sample with numerical descriptors that include the mean and standard deviation while percentage were used for describing categorical data (like gender and demographics).

4.3.1. Participants' Demographics

By nationality, most participants were Irish 17 (74%) with the remaining 26% equally distributed between European Union (EU) 3 (13%) and Non-EU 3 (13%) see table 4-3.

Table 4-3 Nationality

		Frequency	Percent
Valid	Irish	17	73.9
	EU	3	13.0
	Non-EU	3	13.0
	Total	23	100.0

By gender, the ratio of male to female respondents in the experiment was 3 (13%) to 20 (87%).

The largest group of experiment participants 15 (65%) had between three and six months work experience, 3 (13%) of them consisted of those with more than twelve months and another 3 (13%) had worked fewer than three months. The smallest group, 2 (9%), had worked between six and twelve months (table 4-4).

Table4-4 Work Experience

		Frequency	Percent
Valid	0-3 Months	3	13.0
	3-6 Months	15	65.2
	6-12 Months	2	8.7
	>12 Months	3	13.0
	Total	23	100.0

4.3.2. IQ Dimensions - Descriptive Statistics

The descriptive statistics used were the mean ((μ) arithmetic average), the variance showing how data vary in the sample and the standard deviation showing how much the typical score deviates from the mean. The simple ratio measures the ratio of desired outcomes to total outcomes. A formula to incorporate the exceptions is the number of undesired outcomes divided by total outcomes subtracted from 1, where 1 represents the desirable outcome and 0 represents the undesirable outcome. This form of measurement was useful for measuring consistency, accuracy and completeness (section 2-2-3) the measurement formula for accuracy, completeness and consistency are as follows:

$$\text{Accuracy} = 1 - \frac{\text{Number of incorrect data values}}{\text{Total number of values}}$$

$$\text{Completeness} = 1 - \frac{\text{Number of Missing values}}{\text{Total number of items}}$$

$$\text{Consistency} = 1 - \frac{\text{Number of Inconsistent values}}{\text{Total number of values}}$$

Of the 38 individuals volunteering to engage in the experiment, 23 of them participated between November 17th 2008 and November 24th 2008 (a one-week period). They were students of different gender, age and nationalities. Of the total participants, 15 (65%) had been assigned to the control group and 8 (35%) had been assigned to the experimental group by random selection described in section 4-2-2.

The central tendency of a distribution locates the 'centre' of a distribution of values. The three major types of central tendency are the mean, the median, and the mode, which is considered in more detail in the following section. The mean is the most commonly used method of describing central tendency. To compute the mean, the sum of the values for accuracy was taken and divided by the count. For example, the μ IQ accuracy score Σ accuracy scores ⁄N. Similarly the μ IQ score for consistency is determined Σ consistency scores ⁄ N, and the μ IQ completeness score is determined by Σ completeness scores ⁄ N. Table 4-5 shows descriptive statistics for accuracy, consistency and completeness for both control and experimental groups. The control group had μ accuracy, μ consistency and μ completeness levels of (0.51), (0.64) and (0.57) respectively (∑ accuracy_score/15), and the experimental group had μ accuracy, μ consistency and μ completeness levels of (0.66), (0.71) and (0.66) respectively (∑ accuracy score /8. This shows that the experimental group had greater mean accuracy consistency and completeness levels than the control group.

The median is the score found at the middle of the set of values i.e., that has as many cases with a larger value as have a smaller value. One way to compute the median is to sort the values in numerical order and then locate the value in

the middle of the list. The control group median accuracy, consistency and completeness score was (0.51), (0.60) and (0.56) respectively and the experimental group had median accuracy, consistency and completeness score of (0.61), (0.78) and (0.61) respectively. The median score for the control group was less than the experimental group.

The mode is the most frequently occurring value in the set. The mode for the control group, accuracy, consistency and completeness was (0.32), (0.46) (0.34) respectively and the experimental group mode for accuracy, consistency and completeness was (0.57), (0.37) and (0.56) respectively. The mode, for the control group was higher than the experimental group for consistency but lower in both accuracy and completeness.

Dispersion is the spread of values around the central tendency. There are two common measures of dispersion, the range and the standard deviation (σ). The range is the highest value (maximum) minus the lowest value (minimum). The control group had a minimum accuracy, consistency and completeness (0.32), (0.46) and (0.34) respectively and the experimental group had a minimum accuracy, consistency and completeness (0.57), (0.37) and (0.56) respectively. The minimum score for the control group was higher than that for the experimental group for consistency but lower in both accuracy and completeness. The control group had maximum accuracy, consistency and completeness (0.65), (0.83) and (0.76) respectively and the experimental group had maximum accuracy, consistency and completeness (0.86), (0.91) and (0.84) respectively. The maximum score for the control group was lower than that of the experimental group in all dimensions. The control group range for accuracy, consistency and completeness was (0.33), (0.37) and (0.42) respectively and the experimental group had a range for accuracy, consistency and completeness of (0.29), (0.54) and (0.28) respectively. The spread for the control group accuracy (0.33), consistency (0.37) and completeness (0.42)

while the experimental group had a spread for accuracy (0.28), consistency (0.17) and completeness (0.28).This shows that the range for the control group was higher than that of the experimental group for accuracy and completeness but lower for consistency.

The σ is a more detailed estimate of dispersion and shows the relation that set of scores has to the mean of the sample. The control group σ for accuracy, consistency and completeness (0.09), (0.12) and (0.10) respectively and σ for the experimental group was (0.11), (0.20) and (0.11) respectively. The σ of the control group was lower than the experimental group σ. Control group variance (VAR) for accuracy, consistency and completeness was (0.009), (0.015) and (0.011) respectively and VAR for accuracy, consistency and completeness for the experimental group was (0.011), (0.039) and (0.013) respectively. The control group VAR was lower than that of experimental group.

Table 4-5 Control and Experimental Group - Descriptive Statistics

		Control Accuracy	Experiment Accuracy	Control Consistency	Experiment Consistency	Control Completeness	Experiment Completeness
N	Valid	15	8	15	8	15	8
	Missing	8	15	8	15	8	15
Mean		.5115	.6633	.6374	.7075	.5688	.6559
Std. Error of Mean		.02394	.03734	.03171	.06966	.02654	.04022
Median		.5148	.6134	.6042	.7760	.5589	.6091
Mode		.32(a)	.57(a)	.46(a)	.37(a)	.34(a)	.56(a)
Std. Deviation		.09273	.10561	.12280	.19702	.10280	.11375
Variance		.009	.011	.015	.039	.011	.013
Range		.33	.29	.37	.54	.42	.28
Minimum		.32	.57	.46	.37	.34	.56
Maximum		.65	.86	.83	.91	.76	.84

a: Multiple modes exist. The smallest value is shown

4.3.3. Test for Normal Distribution

The degree to which the sample is representative of the population is addressed in this section. Screening for normality was conducted by calculating the Kolmogorov-Smirnov Z test (KS Test) statistic to the sample data to determine if the data in the sample corresponded to a normally distributed data and to show that the data was not significantly different from a normal distribution at $p < 0.05$ level of significance. To arrive at the mean (μ) IQ score, Sigma ($\sum$) of (μ) accuracy, (μ) consistency and (μ) completeness scores were taken before calculating the KS test. All variables had Asymp. Sig. (2 tailed) values of $p > 0.05$ for accuracy consistency and completeness for both groups, and therefore, can be assumed to be normally distributed (table 4-6). Accuracy control group ($p= 0.253$), experimental group ($p= 0.463$), consistency control group ($p= 0.930$), experimental group ($p = 0.825$), completeness control group ($p = 0.948$) and experimental group ($p = 0.825$).

The control group has μ accuracy (0.51) and σ (0.09) and the experimental group has μ accuracy (0.66) and σ (0.11). The control group has μ consistency (0.64) and σ (0.12) while the experimental group has μ consistency (0.71) and σ (0.20). The control group has μ completeness (0.57) and σ (0.10) and the experimental group has μ completeness (0.66) and σ (0.11). As there were no significant difference (NS) between the population percentages and the sample percentages it suggested the sample responses are broadly representative.

Table 4-6 Kolmogorov-Smirnov Test for Normality of Experiment Test Data

		Control Accuracy	Experimental Accuracy	Control Consistency	Experimental Consistency	Control Completeness	Experimental Completeness
N		15	8	15	8	15	8
Normal Parameters a,b)	Mean	.5115	.6633	.6374	.7075	.5688	.6559
	Std. Deviation	.09273	.10561	.12280	.19702	.10280	.11375
Most Extreme Differences	Absolute	.262	.301	.140	.222	.135	.222
	Positive	.112	.301	.140	.154	.096	.222
	Negative	- 262	-.186	-.117	-.222	-.135	-.189
Kolmogorov-Smirnov Z		1.016	.852	.543	.628	.522	.628
Asymp. Sig. (2-tailed)		.253	.463	.930	.825	.948	.825

a Test distribution is Normal.

b Calculated from data.

4.3.4 Independent Sample t-Tests of IQ Means

Having checked for normality and examined the frequency of the data set, statistically significant differences in IQ recording between groups was tested using the most appropriate independent sample t-test procedure. The t-test assesses whether the means of the two groups are *statistically* different from each other and shows whether or not training in accuracy, consistency and completeness can be associated with improved IQ as set out in sub-hypothesis H1a, H1b and H1c Chapter 1, section 1-3. The null hypothesis is H0: $\mu 2-\mu 1 \leq 0$, H1: $\mu 2 - \mu 1 > 0$, where $\mu 1$ is mean of control group and $\mu 2$ is mean of experimental group. Independent sample t-tests were used because the observations are independent and they are the best tests to determine whether the means from the samples are different. First a test for equal variances using Levene's Test for Equality of Variances was employed because the t-test assumes that the data is more or less normally distributed and that the variances are equal.

Table 4-7 shows the test result for equal variances for accuracy $F=0.928$, $p > 0.05$ ($p = 0.346$), which shows accuracy significant at $t (21) = -3.567$, $p = 0.002$**.** Equal variances for consistency $F=2.648$, $p > 0.05$, ($p= .119$). Therefore, the variances are non-significant $t (21) = -10.055$, $p = 0.304$ and equal variances for completeness: $F= 0.545$, $p > 0.05$ ($p =0.469$), $t (21) = -1.867$, $p = 0.076$ and was non-significant. To show whether the model is a reasonable representation of the population, the probability of getting our results by chance alone was computed. The probability of obtaining the accuracy value was ($p = 0.002$), $p < 0.05$, consistency ($p =0.304$), $p > .05$ and completeness ($p= 0.08$), $P >.05$ Therefore only the accuracy dimension was statistically significant and not suggestive of chance alone. However completeness and consistent was not significant (NS).

Table 4-7 Independent Samples T-Test

		Levene's Test Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI Difference	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Accuracy	Equal variances assumed	.928	.346	-3.567	21	.002	-.15183	.04256	-.24034	-.06332
	Equal variances not assumed			-3.423	12.854	.005	-.15183	.04436	-.24776	-0.05589
Consistency	Equal variances assumed	2.648	.119	-10.055	21	.304	-.07001	.06638	-.20806	.06804
	Equal Variances not assumed			-.915	9.987	.382	-.07001	.07653	-.24057	.10055
Completeness	Equal Variances assumed	.545	.469	-1.867	21	.076	-.08709	.04666	-.18413	.00994
	Equal variances not assumed			-1.807	13.177	.094	-.08709	.04819	-.19105	.01686

4.3.5 Participants' IQ Perception

The degree of association between two variables (correlation) can be described by a coefficient: indicating the strength of association. Correlation statistics were used in this section to examine the relationships between participants' IQ perception and IQ. *Pearson's r* parametric statistic was used, which shows the strength of the relationship (0 being none and 1 being a perfect relationship) and the direction of a relationship (-1 to +1). The means for IQ perception and IQ recording was analysed (table 4.8).

Accuracy is positively related to completeness with a Pearson's correlation coefficient of r = 0.896**, N = 23, p <0.01, significant at .01 level. This indicates that high scores in accuracy are associated with high scores in completeness and is statistically significant at .01 level. Accuracy is negatively related to IQ perception with a Pearson correlation coefficient of r = -0.489, N = 23, p < 0.05, significant at the .05 level. This indicates that high scores in accuracy are associated with low scores in IQ perception and is statistically significant at .05 level.

Consistency is negatively related to IQ perception with a Pearson correlation coefficient of r = -0.213, N = 23, p > 0.05. This indicates that high scores in consistency are associated with low scores in IQ perception but is not statistically significant (NS) at .05 level.

Completeness is negatively related to IQ perception with a Pearson correlation coefficient of r = -0.319, N = 23, p > 0.05. This indicates that high scores in completeness are associated with low scores in IQ perception (NS).

Table 4-8 Accuracy Consistency, Completeness and Perceptions of IQ

		Accuracy	Consistency	Completeness	Perception IQ
Accuracy	Pearson Correlation	1	.407	.896(**)	-.498(*)
	Sig. (2-tailed)		0.054	.000	.015
	N	23	23	23	23
Consistency	Pearson Correlation	.407	1	.259	-.213
	Sig. (2-tailed)	0.054		.232	.329
	N	23	23	23	23
Completeness	Pearson Correlation	.896(**)	.259	1	-.319
	Sig. (2-tailed)	.000	.232		.137
	N	23	23	23	23
Perception IQ	Pearson Correlation	-.498(*)	-.213	-.319	1
	Sig. (2-tailed)	.015	.329	.137	
	N	23	23	23	23

** Correlation is significant at the 0. 01 level (2-tailed).

* Correlation is significant at the 00. 05 level (2-tailed).

Perception is negatively related to IQ recording with a Pearson correlation coefficient of is r= - 0.409, N = 23, p =0.052, (table 4-9). This indicates that high scores in perception are associated with low scores in IQ recording and (NS) at .05 level.

Table 4-9 Correlations Perception Grade and Actual IQ

		Perception Grade	Actual IQ
Perception Grade	Pearson Correlation	1	-. 409
	Sig. (2-tailed)		0.052
	N	23	23
Actual IQ	Pearson Correlation	-.409	1
	Sig. (2-tailed)	0.052	
	N	23	23

Statistically significant differences in IQ perception and statistically significant differences between actual IQ grades obtained in the laboratory experiment between groups was tested using the independent sample t-test procedure. It was found that perception grade was not significantly different between groups, (p=.484), p>.05. However, the actual IQ grade obtained in the experiment shows a statistically significant difference between groups with (p=.02), p < 0.05 as shown in (table 4-10).

4.3.6. Impact of Personality on IQ

This section presents the statistics for correlation between IQ and the many elements of conscientiousness trait of the personality. From the personality test we find that Accuracy in the experimental group to Dutifulness has a *Pearson's* correlation coefficient of r = 0.624 N = 8, (p=.098), p > 0.05, which indicates a low association. Accuracy related to Achievement Striving, a *Pearson's* correlation coefficient of r = 0.128 N = 8, (p=.762), p > 0.05, which indicates a very low association. Accuracy related to Self-Discipline, a *Pearson's* correlation coefficient of r = 0.700, N = 8, (p=.053), p > 0.05 which indicates a low association, see (table 4-11).

Consistency in the experimental group related to Dutifulness has a *Pearson's* correlation coefficient of r = 0.304 N = 8, (p=.463), p > 0.05, indicating a very low association. Consistency related to Achievement Striving, a *Pearson's* correlation coefficient of r = -0.210 N = 8, (p=.618), p >0.05 indicating a very low association. Consistency related to Self-Discipline, a *Pearson's* correlation coefficient of r = 0.282, N = 8, (p=.499), p > 0.05, indicating a very low association, see (table 4-11). Completeness in the experimental group related to Dutifulness has a *Pearson's* correlation coefficient of r = 0.576, N = 8, (p=.135), p > 0.05, which indicates a low association.

Completeness related to Achievement Striving, a *Pearson's* correlation coefficient of r = 0.288 N = 8, (p=.488), p > 0.05 indicates a very low association. Completeness related to Self-Discipline, a *Pearson's* correlation coefficient of r =0.617, N = 8, (p=.103), p > 0.05 indicates a low association see (table 4-11).

Accuracy in the control group related to Dutifulness has a *Pearson's* correlation coefficient of r = -0.288 N = 15, (p=.298), p >0.05 indicates a very low association. Accuracy related to Achievement Striving, a *Pearson's* correlation coefficient of r = -0.357 N = 15, (p=.192), p > 0.05 also indicates a very low association, and Accuracy related to Self Discipline, a *Pearson's* correlation coefficient of r = - 0.164, N = 15, (p=. 559), p > 0.05, indicates a very low association, see (table 4-12).

Consistency in the control group related to Dutifulness has a *Pearson's* correlation coefficient of r = - 0.168 N = 15, (p=.549), p > 0.05 indicates a very low association. Consistency related to Achievement Striving, a *Pearson's* correlation coefficient of r = -0.238 N = 15, (p=.393), p > 0.05 indicates a very low association, and Consistency related to Self Discipline, a *Pearson's* correlation coefficient of r = -0.073, N = 15, (p=.795), p > 0.05 indicates a very low association, see (table 4-12).

Completeness in the control group related to Dutifulness has a *Pearson's* correlation coefficient of r = -0.120 N = 15, (p=.669), p > 0.05 indicates a very low association. Completeness related to Achievement Striving, a *Pearson's* correlation coefficient of r = -0.189 N = 15, (p=.499), p > 0. 05 also indicates a very low association, and Completeness related to Self Discipline, a *Pearson's* correlation coefficient of r = 0.043, N = 15, (p=.880), p > 0.05, indicates a very low association, see (table 4-12).

Table 4-10 Independent Samples Test Perception Grade and Actual Grade Obtained

		Levene's Test for Equality of variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% C I of the Difference	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Perception Grade	Equal variances assumed	1.815	.192	.712	21	.484	.22667	.31843	-.43554	.88887
	Equal variances Not assumed			.976	14.750	.345	.22667	.23227	-.26914	.72247
Actual IQ	Equal variances Assumed	.571	.458	-2.507	21	.020	-.10298	.04107	-.18839	-.01757
	Equal variances Not assumed			-2.288	11.269	.042	-.10298	.04501	-.20176	-.00419

Table 4-11 Correlations for Experimental Group

		Experiment Accuracy	Experiment Consistency	Experiment Completeness	Dutifulness	Achievement Straining	Self Discipline
Experimental Accuracy	Pearson Correlation	1	.365	.973(**)	.624	.128	.700
	Sig. (2-tailed)		.374	.000	.098	.762	0.053
	N	8	8	8	8	8	8
Experimental Consistency	Pearson Correlation	.365	1	.247	.304	-.210	.282
	Sig. (2-tailed)	.374		.556	.463	.618	.499
	N	8	8	8	8	8	8
Experimental Completeness	Pearson Correlation	.973(**)	.247	1	.576	.288	.617
	Sig. (2-tailed)	.000	.556		.135	.488	.103
	N	8	8	8	8	8	8
Dutifulness	Pearson Correlation	.624	.304	.576	1	.068	-.021
	Sig. (2-tailed)	.098	.463	.135		.759	.923
	N	8	8	8	23	23	23
Achievement Striving	Pearson Correlation	.128	-.210	.288	.068	1	.327
	Sig. (2-tailed)	.762	.618	.488	.759		.127
	N	8	8	8	23	23	23
Self- Discipline	Pearson Correlation	.700	.282	.617	-.021	.327	1
	Sig. (2-tailed)	0.053	.499	.103	.923	.127	
	N	8	8	8	23	23	23

** Correlation is significant at the 0. 01 level (2-tailed).

Table 4-12 Correlations for Control Group

		Control Accuracy	Control Consistency	Control Completeness	Dutifulness	Achievement Straining	Self-Discipline
Control Accuracy	Pearson Correlation	1	.346	.868(**)	-.288	-.357	-.164
	Sig. (2-tailed)		.206	.000	.298	.192	.559
	N	15	15	15	15	15	15
Control Consistency	Pearson Correlation	.346	1	.153	.168	-.238	-.073
	Sig. (2-tailed)	.206		.587	.549	.393	.795
	N	15	15	15	15	15	15
Control Completeness	Pearson Correlation	.868(**)	.153	1	-.120	-.189	.043
	Sig. (2-tailed)	.000	.587		.669	.499	.880
	N	15	15	15	15	15	15
Dutifulness	Pearson Correlation	-.288	.168	-.120	1	.068	-.021
	Sig. (2-tailed)	.298	.549	.669		.759	.923
	N	15	15	15	23	23	23
Achievement Straining	Pearson Correlation	-.357	-.238	-.189	.068	1	.327
	Sig. (2-tailed)	.192	.393	.499	.759		.127
	N	15	15	15	23	23	23
Self- Discipline	Pearson Correlation	-.164	-.073	.043	-.021	.327	1
	Sig. (2-tailed)	.559	.795	.880	.923	.127	
	N	15	15	15	23	23	23

4.4. Interviews with Patients

Cunningham (1993) argues that interviews are an important part of any research project. They provide the opportunity for the researcher to gather data, which could not have been obtained in other ways, and help further investigate and solve problems. Interviews are particularly useful for getting the story behind a participant's experiences (McNamara 1999). Interviews were used as a follow-up to experiment to investigate the patient participant's experience of the patient care received. Therefore, immediately following the experiment, a face-to-face, group interview with three subjects, (who had previously role played as patients), was conducted. The venue selected for the group patient interviews was the virtual hospital environment where the experiment had just taken place.

The purpose of the interviews was fully explained to the interviewees and confidentiality was guaranteed. A standardized open-ended interview was employed with open-ended questions where respondents were free to answer as desired. This approach facilitated faster interviews which could be more easily analyzed and compared. The total time required for the group discussion was 30 minutes. Two major themes emerged from the analysis: 1) patient interaction and 2) time spend recording patient data. During the interviews all subjects described how they became increasingly aware of the lack of patient interaction from the experimental group who showed more interest in checking data in comparison to the control group who were more interested in patient interaction. They indicated that they felt that the time spent recording patient details was significantly longer with the experimental group. A limitation of the interview include the small sample size participants (N = 3).

4.4.1. Group Discussions

Group discussions are useful in exploring perceived ideas of the predictors of IQ; however, our purpose in using group discussions was two-fold: 1) to ascertain which IQ predictors should be investigated and measured by the survey, in order to provide a useful and usable training plan model and training guideline: 2) to identify the nurses' attitudes and their perceptions of IQ importance and training in general. The group discussion was also useful in exploring barriers to the effectiveness of training. A group discussion provided information to help develop and further investigate the problem using an online survey instrument distributed to the real world hospital target population as opposed to trainee nurses within a virtual hospital environment. The discussion took place at the workplace of the subjects from the experiment sample.

The group discussion was a qualitative data gathering technique, essential in the evaluation process, after completion of the experiment. The discussion technique was used to determine participants' opinions about their experience, and the practicality and usefulness of the experiment and training. Twelve experimental volunteers participated and questions were unstructured so as to allow the respondents to contribute from a variety of dimensions. Topics were carefully selected and phrased to elicit a maximum response from them. The open-ended questions asked were:

- 'What do you think was the biggest barrier to IQ recording in the experiment?'
- 'Do you think it is important to record information in a serious quality manner?'
- 'How did you feel about the training?'
- 'How important do you think documentation recording is?'
- 'Do you agree that the dimensions selected for training were justified?'

The group discussion lasted one hour. Participants were assured that the proceedings were confidential and that their names would not be used in the report. It was also established that there were no right or wrong answers and that the objective of the exercise was to understand the opinions the group held about IQ importance, the experiment in general, and training. The IQ discussion on the experiment experience was to establish if they considered it beneficial, with regard to their career. It was emphasised that a `no holds barred' discussion should be encouraged to establish how they felt about the experiment and training, even if it might be negative.

When it came to the importance of IQ recording, participants continually mentioned the shortage of time to check their input and several of them suggested that it consisted of a lot of 'unnecessary work'. The general consensus was that the time used to check data could be used more effectively to attend the needs of patients.

Regarding training, one participant said, 'I don't think consistency is all that important'. Another summed it up: ''Everyone knows the format it should be recorded in and I can't see the point in wasting time with format'.

A frequently mentioned reason for poor IQ recording of patient information was highlighted: 'It was just an experiment and not in real a hospital, and if it had been a real hospital we would have recorded the information perfectly'. Another response included 'recording quality information in an experiment is of no benefit to us for our degree'.

A major barrier to IQ recording in the experiment by all participants was time commitments to academic assignments, which was an integral part of their degree. 'Investing time in IQ recording for the experiment, which does not enhance the degree grade, is a hassle and a waste of time that could be

invested in assignments that go towards our overall degree,' are the words of one participant.

The next step was to analyse the content of the discussion and the aim of the analysis was to look for trends and patterns. Three major trends appeared: 1) assignment pressures, an intrinsic part of their degree; 2) the virtual environment, which many disclosed was not a real life hospital, and 3) a 'don't care' or 'could not be bothered' attitude, where some viewed the experiment as just an exercise, and so, therefore, did not take it seriously. The experiment participants confirmed the words of authors such as Galliers (1991)

> *"a key weakness of the experiment is the 'limited extent to which identified relationships exist in the real world because of over simplification of the experimental situation and isolating such situations from most of the variables that are found in the real world."*

Therefore, further investigation was attempted with a web based survey to mitigate some of these issues (see Chapter 5). This feedback helped in stimulating new ideas and it created concepts for further investigation, through the survey approach described in Chapter 5.

4.4.2. Observation from Experiment

Direct observation was selected where participants were aware that they were being observed and the danger was that they could be *reacting* to it. In order to obtain reliability, behaviour should be observed several times. However, as time went on, the presence of the observers did not seem to pose any problems. The subjects appeared to grow accustomed to the observer's presence and appeared to act in a very relaxed manner. The mood of the experimental participants was somewhat pleasant and they showed signs of anticipation and good documentation recording behavioural signals to the task

in hand. Observations were interpreted using inferential observational variables that required making inferences about what was observed. Direct observation of the groups' activities during the experiment suggested that 1) although it is not possible to see attitudes, behavioural observation was possible and therefore inferences about attitudes could be made, that may be attributed to the participants' personality. This was further emphasised by the findings of the group discussions. Further findings demonstrated that 2) conflict with integrating new information into practice in a short period of time after training, and 3) student perceptions and attitude to the experiment in the virtual environment. These observations provided constructs for consideration when investigating the IQ training problem in the real world setting and suggested possible avenues for future research.

A limitation of the observational research is that the findings only reflect a unique population of trainee student nurses and may not be representative of the population; also, the behaviour patterns observed are not representative of the individual. Therefore it cannot be generalized to others.

4.5. Key Findings

This section gives a brief summary of the key findings from the experiment and discussion groups, which helped form the basic constructs for the survey instrument discussed in Chapter 5. The experimental group had higher mean, median and mode for accuracy, consistency and completeness, which would indicate that training had some impact on these dimensions even though the impact was not statistically significant across all dimensions. There was no statistically significant difference in completeness and consistency between experimental and control groups. However, there was a statistically significant difference in accuracy between the groups $p = .02$; $p < .05$ level of significance. This result suggested that the subjects who were trained in IQ dimensions did

statistically significantly better in accuracy recording than those who were not. The IQ perception grade was not significantly different between groups, p=.484 ; p> 05. Non EU student nurses were more accurate and had more completeness levels whereas; EU student nurses had higher levels of consistency. Irish student nurses did not perform as well, in all three dimensions of IQ documentation recording.

There was a high positive correlation between Accuracy and Self Discipline in the experimental group, and a low negative correlation between Accuracy and Self Discipline in the control group. There was a high positive correlation between Accuracy and Dutifulness in the experimental group, and a low negative correlation between Accuracy and Dutifulness in the control group. There was a low positive correlation between Accuracy and Achievement Striving in the experimental group, and a low negative correlation between Accuracy and Achievement Striving in the control group.

There was a low positive correlation between Consistency and Self Discipline in the experimental group, and a low negative correlation between Consistency and Self Discipline in the control group. There was a low positive correlation between Consistency and Dutifulness in the experimental group, and a low positive correlation between Consistency and Dutifulness in the control group. There was a low negative correlation between Consistency and Achievement Striving in both the control and experimental group.

There was a high positive correlation between Completeness and Self Discipline in the experimental group, and a low positive correlation between Completeness and Self Discipline in the control group. There was a high positive correlation between Completeness and Dutifulness in the experimental group, and a low negative correlation between Completeness and Dutifulness in the control group. There was a low positive correlation between

Completeness and Achievement Striving in the experimental group, and a low negative correlation between Completeness and Achievement Striving in the control group. None of the correlations of these elements are statistically significant at the $p < .05$ as shown in table 4-13 where (+) represents a positive correlation and (-) represents a negative correlation.

Table 4-13 Correlation Table and Significance

Correlations of Self Discipline, Dutifulness and Achievement Striving within Groups						
	Accurate Control	Consistent Control	Complete Control	Self Discipline	Dutiful ness	Achievement Striving
Accurate Experimental				High +. (700)	High + (.624)	Low + .(128)
Consistent Experimental				Low + (.282)	Low + (.304)	Low – (-.210)
Complete Experimental				High + (.617)	High + (.576)	High + (.288)
Self Discipline	Low – (-.164)	Low – (-.073)	Low + (.073)			
Dutifulness	Low – (-.288)	Low + (.168)	Low – (-.120)			
Achievement Striving	Low – (-.357)	Low – (-.238)	Low – (-.189)			

Findings from the patient interviews suggested that interest in documentation recording after training had increased to the extent that it affected patient bedside manner and that the Accuracy IQ dimension was the dimension that was considered most important. Accuracy is positively related to completeness with $p<0.01$, which suggests that these dimensions are not innately independent. The findings suggested that extended time spent checking data entered for accuracy could have a direct impact on completeness.

Documentation recording time may decrease with documentation recording experience so further research should be conducted on the impact of training on all dimensions of IQ, and an analysis of how documentation recording experience impacts on IQ.

The group discussion provided feedback on potential IQ predictors to be further investigated: 1) the work environment; 2) conscientiousness; 3) documentation

recording experience; 4) training duration and training intervals, and 5) perception of IQ importance.

4.6. Summary

This chapter outlined the main stages of the controlled experiment setup for data collection which included group discussions with participants, interviews with patients and observations from two experimenters. Simple random sampling was conducted, whereby each member of a population had an equal opportunity to become part of either the control or experimental group.

CHASEtown, virtual hospital environment in Dublin City University, School of Nursing, Ireland, was utilised to simulate the activities of a typical hospital environment. The goal based scenario was conducted, in which nurses assume their main role - attending to routine nursing activities. Their mission was to accomplish the task associated with the main role in the scenario, such as admitting patients, taking and recording vital signs, giving medication and discharging patients.

The experiment provided a framework for suggesting a relationship between training and improved IQ. The chapter described how the data was analysed and it presented the findings from phase one of the study. A range of data analysis methods were employed on the data. The descriptive statistics used were the mean, and variance, showing how data vary among the sample; and standard deviation, showing how much the typical score deviates from the mean. Correlation statistics were used to examine the relationships between training and IQ. *Pearson's r* statistic, which shows the strength of the relationship and the direction of a relationship, was used. The experimental focus was aimed at examining the impact of training which IQ dimensions has on IQ.

The main finding illustrates that the experimental group had higher mean, median and mode for Accuracy, Consistency and Completeness, even though the impact was not statistically significant across all dimensions. Accuracy was shown to be positively related to Completeness, which suggests that these two IQ dimensions may not be innately independent. Non EU student nurses were more Accurate and had more Completeness levels than Irish and EU student nurses, and EU student nurses had higher levels of Consistency than both Irish and non EU student nurses.

There was a high positive correlation between Accuracy and Self Discipline, and Accuracy and Dutifulness in the experimental group. There was a low positive correlation between Consistency and Self Discipline and Consistency and Dutifulness in the experimental group. There was a high positive correlation between Completeness and Self Discipline and Completeness and Dutifulness in the experimental group. In Chapter 5 the survey phase of the study is described in detail and an analysis of the main findings is presented which will provide a basis for the information quality training requirements analysis guideline development in Chapter 6.

Chapter 5

SURVEY INSTRUMENT

5.1. Introduction

Chapter 4 presented the findings from the experiment phase of the study, described how the data was analysed and provided the constructs for the survey which will be presented in detail in this chapter together with the findings from the survey phase of the study. In preparation of the analysis, the data was examined and coded into SPSS (Statistical Package for Social Sciences) 15.0 for Windows. The values were calculated as the statistical mean of the items associated with each group. Data were subjectively measured on a 5-point Likert scale.

To investigate the research proposition presented in hypothesis H1- H6, a web based survey questionnaire (Appendix H) was designed and administered. This explored the following:

1. If training can be associated with improved IQ (H1).

2. If conscientiousness can be associated with improved IQ (H2).

3. If training design can be associated with improved IQ (H3).

4. If the work environment can be associated with improved IQ (H4).

5. If experience can be associated with improved IQ (H5).

6. If perception of the importance of IQ can be associated with improved IQ (H6).

The opinions and views of healthcare practitioners were obtained from the answers provided by respondents.

The use of a questionnaire instead of more objective measures of IQ was based on the respondents' capacity to truthfully and accurately answer the questions. Nearly everyone has had some experience completing questionnaires and they generally do not make people apprehensive. Unlike other research methods, the respondent is not interrupted by the research instrument, which is less intrusive than face-to-face surveys. Moreover questionnaires reduce *interviewer bias* because there is uniform question presentation (Jahoda et al.1962). Unlike in-person interviewing, there are no verbal or visual clues to influence a respondent to answer in a particular way.

A questionnaire was selected because it was the most inexpensive and feasible way to gather data from a large enough number of participants to allow statistical analysis of the results to test the hypothesis (Kirakowski 1997; Dillman 2000). This belief forms the basis of the use of questionnaires in general and was further strengthened by the normal distribution of answers to the questions.

5.2. Survey Research Design

This survey was a quantitative analysis exploring the predictability of IQ based on training, work environment and trainee characteristics in order to provide data to develop an Information Quality Training Analysis Guideline to aid design of Information Quality Training Plans which will be detailed further in Chapter 6. Performance indicators were evaluated from the different perspectives of healthcare officials including nurses, physicians, administration

staff, clerks and laboratory technicians. This was then measured by evaluating the perceived accuracy, consistency and completeness of patient admission records.

Adaptations of Baldwin & Ford (1988) transfer of training model was deemed suitable as a base for this study as it recognises the importance of trainee characteristics, training design and the work environment on performance, and therefore, was used for developing the IQ conceptual model (figure 1-1).

The primary goal of the survey was to identify if work environmental factors; trainee characteristic (conscientiousness); training design factors and experience predict IQ and if so how best to incorporate this information into the development of an Information Quality Training Analysis Guideline IQTRAG discussed in Chapter 6. Work environmental factors included IS, peer support and form layout. Trainee characteristic (conscientiousness) included: self-efficacy, self-discipline, achievement striving and dutifulness; training design factors included: training frequency, and training duration.

5.2.1. Survey Methodology

In undertaking this study a specific procedure was followed. A literature review from the disciplines of QM, TQM, IQM and training formed the basis for developing the conceptual model. In an exploration of the literatures many important predictors were identified but it must be stressed that these are in no way exhaustive (table 5-1).

Table 5-1 **Identification of Information Quality Predictors**

Predictors	Factors
Work Environment	Information System
	Information Gathering Format
	Peer Support
Trainee Characteristics	Dutifulness
	Self-Efficacy
	Achievement Striving
	Self-Discipline
Training	Training Duration
	Training Sequencing
Other Factors	Documentation Experience
	Work Experience

A questionnaire was specifically designed to measure these IQ predictors and then explored through a quantitative analysis to show that IQ outcomes could be predicted by trainee characteristics (conscientiousness), training design, sequencing, elements of the work environment, importance of IQ perception, and documentation recording experience.

The questionnaire consisted of 65 items and was divided into sections. One section contained demographic characteristics of the respondents such as age, gender, profession as well as the number of years spent in the hospital. Another explored employee's perceptions of IQ, with particular emphasis on accuracy, consistency and completeness of patient admission data. A training section contained questions that identify the adequacy of the training programs, training duration, and training intervals. The work environment section contained questions that identify the IS mainly used in admitting patients, form layout, and peer support. In addition to this, the trainee characteristics section contained questions that identify the level of conscientiousness of participants

under the constructs of self-discipline, self-efficacy, dutifulness, and achievement striving, using the Goldberg NEO_PI personality test.

A questionnaire was initially drafted and pre-tested with academics and IQ experts to check its content validity and terminology, and was adjusted accordingly to ensure unambiguous terminology. The adjusted questionnaire was then tested to check its aptness and appropriateness for the target population, before distribution.

Some of the survey items were based on existing items from validated instruments found in the research literature (Goldberg 1990; Wang & Strong 1996). Many of the survey items (Personality traits) had been widely validated in various settings (Goldberg 1990), while others (IQ elements) had been validated in more limited contexts (Wang & Strong 1996). However, these survey items had not previously been used together within a single instrument and for this reasons, statistical tests were conducted to support the instrument in the context of this study's population and to test the reliability and validity of the combined instrument.

The design of the questionnaire was a multi-stage process beginning with an understanding of the aspects to be explored and ending with interpretation of the results. The following is a broad outline of the steps followed in designing and administering the questionnaire:

1. Objectives of the survey defined.
2. Sampling group determined.
3. Questionnaire appropriately designed.
4. Questionnaire rigorously tested
5. Questionnaire administered to predetermined sampling group.
6. Results analysed and interpreted.
7. Conclusions drawn.

First, the objectives of the study were defined so a clear goal and purpose was created in order not to overlook important issues or waste participants' time answering useless questions. The following list questions were used to gather data:

1. IQ in patient admission forms.
2. Work environment structure.
3. Trainee characteristics.
4. Training perception duration and intervals.
5. Demographics.
6. Documentation experience.

The dependent variables were those used to measure IQ. These variables were operationalised at the dimension level and measured directly using 13 survey items from Wang & Strong (1996) instrument. Several items from that instrument were discarded because they are used to measure dimensions not included in this study. This instrument utilized a scale from 1 to 5, where 1 represents very low and 5 represents very high. One dependent variable per outcome dimension was calculated as the mean value of the response items measuring that particular dimension.

Conscientiousness was tested by NEO_PI based on the five factor model (Costa & McCrae 1992) and measured on a 5 point scale that formed two poles ranging from strongly disagree to strongly agree. The scores of each of the 16 items, which measured the four constructs of conscientiousness, were summarised and each respondent obtained a raw score for each of the four constructs.

5.2.2. Survey Design

According to Kirakowski (1997), closed-ended questionnaires are good when processing massive quantities of data, or the questionnaire can be appropriately scaled to yield meaningful numeric data. Therefore, closed format questions that took the form of multiple-choice answers were employed. Likert scales are concerned with developing a batch of items which have approximately the same level of importance to the respondent, and are all more or less talking about the same concept, which is the concept the scale is trying to measure (Kirakowski 1997). Therefore, these questions in this questionnaire were structured using the Likert scale wherein respondents had been given a select number of response choices which were pre-coded, but gave enough choices to fully cover a range of answers and not so many choices that the distinction between them became blurred. Likert scaling provides the ability to sum up the scores on the individual items, to yield a questionnaire score that can be interpreted as differentiating between shades of opinion, from 'completely against' to 'completely for' the measured construct (Kirakowski 1997).

This rating scale requires the subject to indicate his or her choice which best represents the degree of agreement/disagreement on the given question/statement. In this survey five choices were provided for every question. For example, questions that measured a single opinion, such as:

> *'I feel that the duration between documentation training programmes attended, were usually of adequate length. '*

Five options from a range of strongly disagree to strongly agree was provided. Questions were posed as clearly and unambiguously as possible to eliminate

the possibility that the question could mean different things to different people. For example, when asking a question such as:

> '*The time I spend recording patient information relative to other duties is?'*

Precise choices to quantify the answers were provided and the following scale was used to interpret the responses of all respondents for the question, by computing the weighted mean.

Score	**Interpretation**
0 %	1
1-25%	2
26- 50%	3
51-75%	4
75- 100%,	5

Leading questions that force or imply a certain type of answer were also included and the following choices of answers were supplied that not only covered a whole range of responses but were equally distributed throughout a range of answers: for example

> *'I have received specific documentation training to maintain/improve my skills and competency levels for the job I am charged with doing'.*

The following answer choices were provided and interpreted as follows:

Score	Interpretation
Strongly Disagree	1
Disagree	2
Neither Agree or Disagree	3
Agree	4
Strongly Agree	5

The Likert form was the selected questionnaire type for this study as it enabled the respondents to answer the survey easily. In addition, this technique allowed the researcher to carry out the quantitative approach effectively with the use of statistics for data interpretation. Additionally there were dichotomous questions throughout the survey to which the respondent answer, either 'yes' or 'no' for example *'is there a formal training program in your department'?*

Once the questionnaire was completed it went through quality testing. The major hurdle in our questionnaire design was making it clear and understandable to all. A review of the questionnaire was taken and all points that were in any way ambiguous were discussed and reworked as necessary. This step was continually repeated until it was believed to be of an acceptable standard for distribution. Therefore the questionnaire design was a long process that demanded careful attention to make it into a powerful and economic evaluation tool.

5.2.3. Validity of the Survey Instrument

The validity of a questionnaire is the degree to which it is actually measuring or collecting data about what you think it should be measuring or collecting data about (Kirakowski 1997). Thus, to test the validity of the survey the researcher tested the questionnaire on twenty respondents from the academic, IQ and medical professions. These respondents, as well as their answers, were only used for testing purposes. After the questions had been answered, the researcher asked the respondents for suggestions, or necessary corrections, to ensure further improvement and validity of the instrument. The researcher then excluded irrelevant questions and changed vague or difficult terminologies to ensure understanding. Most items in the survey instrument were drawn directly from prior studies for which construct validity had already been determined to some degree, such as Goldberg's NEP_PI (Goldberg 1990).

5.2.4. Reliability of the Survey Instrument

The reliability of a measurement instrument determines its ability to yield consistent measures when filled out by like-minded people in similar circumstances (Kirakowski 1997). It is usually expressed on a numerical scale from zero (very unreliable) to one (extremely reliable):

> *If the reliability coefficient is low (near to zero) this means that some of the items may be more important to the respondents than others. If the reliability coefficient is high (near to one) then the items are most probably all of the same psychological size'* (Kirakowski 1997).

The reliability of this study was operationalized as consistency, completeness and accuracy, which is the degree of inter-correlation among the items that comprise a scale. Cronbach's α was calculated for each scale. Items which do not correlate well are clearly not part of the scale (going in a different 'direction') and should be thrown out or amended (Kirakowski 1997). According

to Kirakowski (1997) long questionnaires, as a rule of thumb, should yield reliability values of 0.70 or more, therefore, the scale was accepted if it had a strong α value of at least 0.70. Scales with α values less than 0. 70 were further analysed to determine whether α could be improved by the removal of some items (Kirakowski 1997).

5.2.5. Survey Sampling Frame

Specifically, 1200 respondents were randomly selected for the sample. The target population for this study included doctors, nurses, laboratory workers, clerks and administration staff from hospitals in Ireland. All subjects were volunteers and received no pay or credit for this activity. To establish the size of the survey population a sampling frame was taken from a contact database from Dublin City University, Ireland, of past nursing students and from major hospital boards. This produced an initial sample listing of 1,200. Telephone contact was established with hospitals, and a key contact was identified to select which individuals were responsible and capable of responding to questions on training, quality, and work environment, which included doctors, nurses, administration staff, clerks and laboratory technicians who had reason to record or use information on admission data on a day-to-day basis. This step was taken to improve the quality and quantity of responses.

5.2.6. Procedure

The study used an electronically administered web based survey hosted on a server operated by Survey Monkey. Participants were invited to respond electronically and were provided with the web address of the survey. After accessing the on-line survey through the address provided, participants marked their responses by making selections on a series of screens. On

completion of the survey, participants submitted their responses to the server, where they were stored until retrieved for analysis.

Demographics were collected to analyse gender, experience, nationality, occupation, and IQ view in general. Dewey (1938) suggested that it is experience and context that serve as a foundation for education and knowledge. Therefore a section of the questionnaire was given to discover the level of experience individuals had at documentation recording. Taken that experience is an important predictor of IQ it must be acknowledged that there may be other influences (Peter & Jarvis 1991), such as how the person interprets IQ importance. Therefore, the questionnaire also collected information related to the subjects' perception of errors, inconsistencies and incompleteness in documentation of patient admissions in their hospital. This gave subjective measurements of IQ.

Data on opinion of training offered and duration and intervals between them was also gathered. The quality of the documentation training received, if any, and their perception of the impact of trainee characteristics in documentation quality was accessed.

Response data collected from the web server was downloaded as an excel spreadsheet. Most items used a 5 point Likert scales with values from 1 through 5. Questions used binary numbers with values from 0 through 1 and were coded automatically using this scale. Categorical data was also collected for grouping purposes and were assigned an integer code associated with a fitting text label in SPSS. All variables used in hypothesis testing were associated with a set of survey items. The values for these group item variables were calculated as the statistical mean of the items associated with each variable. The hypotheses were tested using multiple

regression analysis. A summary of findings from the study was prepared and factors that predict IQ identified in section 5-3-7.

5.2.7. Survey Data Measurements

The traditional way of measuring IQ relies on quantifying how data relate to the dimensions of IQ. After a review of the literature on IQ metrics, the measurement criteria for this study were chosen, and grouped into three categories: accuracy, consistency and completeness. In the survey as in the experiment phase detailed in Chapter 4, two types of variables were identified: dependent variables that measure various dimensions of IQ, and independent variables that measure perceptions of IQ, trainee characteristics, work environment, experience and training. A set of demographic variables was also identified for grouping purposes. The IQ dimensions were identified using Wang's framework and the IQA developed by Lee et al. (2002), and measured using Redman (1995) metric section 2-2-3. Survey questions that measured the dimensions of accuracy, completeness and consistency are listed in table 5-2**.**

The survey instrument used a Likert scale from 1-5, where 1 represents always and 5 represents never. The dimension was calculated as the mean score of the survey item responses that measured that dimension. Each of the hypotheses was tested using multiple regressions. Multiple regression analysis is a methodology for empirically examining sets of relationships represented in the form of linear models. The output of the regression analysis had two parts which are of interest to this study: the model summary and the ANOVA table. The model summary R^2 tells how much of an impact the independent variable predicts the dependent variable, and the ANOVA table shows the degree to which the relationship was linear. The F-test is the level of significance (Mertler & Vannatta 2005).

Table 5-2 Dependent Variables

Completeness	How often do you find patient identification number (MRN) not filled in?
	How often do you find incomplete patient histories?
	How often do you find patient admission forms not signed by admission staff?
	How often do you find the patient's Date of Birth (DOB) missing?
	How often do you have to fill in missing information that should have been recorded?
	How often do you find the patient's address not recorded fully?
Consistency	How often do you find date of admission not filled in the standard (required) format?
	How often do you find patient Date of Birth (DOB) written in a non-consistent format?
	How often do you find patient's weight recorded in the correct format?
Accuracy	How often do you find typographic errors (misspelling) in a patient file?
	How often do you find the Patient's identification number (MRN) recorded inaccurately?
	How often do you need to make corrections to incorrect information recorded by colleagues?
	How often do you find patient's Date of Birth (DOB) not accurately recorded?

Another focal point in the study is the relation between 'conscientiousness' and 'IQ'. The independent variables uses were those to measure trainee characteristics. The constructs were measured using (Goldberg 1990) NEP_PI framework. The survey instrument uses a Likert scale from 1-5 where 1 represents strongly disagree and 5 represents strongly agree. Each construct was calculated as the mean score of the constructs under self-discipline, self-efficacy, dutifulness and achievement striving (table 5-3), training (table 5-4), work environment and general perception of IQ (table 5-5).

Table 5-3 Independent Variables

	I usually get chores done right away
	I am always prepared for every event
	I always carry out my plans
	I usually postpone making decisions for as long as possible
	I usually go straight for the goal
	I usually turn plans into actions
	I tend to set high standards for myself and others
	I am not really highly motivated to succeed
	I try to follow the rules and seldom break them
	I usually listen to my conscience
	I sometimes break my promises
	I sometimes misrepresent the facts
	I usually complete tasks successfully
	I usually excel in everything I do
	I usually come up with good solutions to problems
	Sometimes I may misjudge situations

Table 5-4 Training Questionnaire

Training	There is a formal documentation recording training program in my department
	I have received specific documentation training to maintain/improve my skills and competency levels for the job I am charged with doing
	I feel that time intervals between documentation training programs attended were appropriate
	I feel the duration of documentation training program(s) attended were usually of adequate length
	The duration of documentation training program(s) I attended were usually
	The effectiveness of the training received was usually
	My experience of documentation recording is
	My colleagues' documentation recording quality is
	Of the training day(s) you attended in the past calendar year, what percentage was dedicated specifically to documentation training

Table 5-5 Work Environment & IQ Perception Questionnaire

Work Environment	Patient Admission Forms I fill out are mainly?
	The patient admission form layout I mainly fill is?
	There is good respect and peer support from team members within our organization.
	The work environment is?
	My work climate encourages quality care and continuous improvement.
IQ Perceptions	How long are you an employee with this organisation?
	How would you rate the current quality of documented information in your department?
	Overall I am satisfied with the quality of patient admission information in my organisation.
	I feel the consequence of not recording information correctly on Patient Forms is?

Classification variables were used for identifying information about participants which allowed respondents to be grouped for analysis. Classification questions were used to collect information on participant's job, gender and nationality (table 5-6).

Table 5-6 Classification Variables

Classification	Gender
	Nationality
	Profession

5.3. Survey Findings

All data were examined and coded into SPSS (*Statistical Package for Social Sciences*) 15.0 for Windows. A range of data analysis methods was employed on the data. Data was evaluated using multiple regression and correlation analysis. Correlation analysis refers to studies in which the purpose is to discover relationships between variables by using correlation statistics The degree of association between two variables (correlation) is described by the coefficient; indicating the strength of association. The values were calculated as the statistical mean of the items associated with each group. Analysis

included demographic information, section 5-3-1; response analysis, section 5-3-2; descriptive statistics, section 5-3-3; testing for normal distribution conducted by calculating the KS test statistic, section 5-3-4; construct analysis using Cronbach's α, section 5-3-5; independent sample t-tests on IQ means between groups, section 5-3-6 and IQ perception, section 5-3-7. Each of the hypotheses was tested using multiple regression section 5-3-8.

5.3.1. Demographics

The ratio of male to female was 40 (20%) :158 (80%), and geographically, most subjects who responded were Irish 131 (66%) with the remaining 67 (34%) being of Non-Irish origin (table 5-7).

Table 5-7 Nationality of Survey Participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Irish	131	64.9	66.2	66.2
	Non-rish	67	33.2	33.8	100.0
	Total	198	98.0	100.0	
Missing	System	4	2.0		
Total		202	100.0		

The largest group of survey respondents had more than seven years experience (26%), those with five to six years (17%), three to four years (25%), two to three years (23%), and the smallest group had less than one year (9%), (see table 5-8.

Table 5-8 Work Experience of Survey Participants

How long are you an employee with this organization					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 -1 yr	17	8.4	8.5	8.5
	2- 3 yrs	46	22.8	23.1	31.7
	3 - 4 yrs	49	24.3	24.6	56.3
	5 - 6 yrs	34	16.8	17.1	73.4
	> 7 yrs	53	26.2	26.6	100.0
	Total	199	98.5	100.0	
Missing	System	3	1.5		
Total		202	100 0		

5.3.2. Response Analysis

Of the 1,200 medical professionals invited to take part in the web-based survey, 202 responded, comprising of subjects of different professions. Of the total responses, nurses account for 155 (77%), doctors 19 (9%); administration staff 13 (7%) and other participants 14 (7%) giving an overall response rate of 17% (table 5-9). Nurses were the largest group of respondents to the survey followed by doctors and administration staff.

Table 5-9 Responses by Profession

		Frequency	Percent
Valid	Physician	19	9.4
	Nurse	155	76.7
	Administration Staff	13	6.4
	Other	14	6.9
	Total	201	99.5
Missing	System	1	.5
Total		202	100.0

5.3.3. Descriptive Statistics

Descriptive statistics is shown in table 5-10. From these statistics we note a mean (average) IQ score of 2.39, median 2.39, mode score of 2.56, minimum 1.00, maximum 3.97, standard deviation 0.62, variance 0.384, and range 2.97. Here we note the IQ mean and the IQ median scores are the same while the mode is lower.

Table 5-10 Descriptive

N	Valid	202
	Missing	0
Mean		2.3852
Std. Error of Mean		. 04361
Median		2.3889
Mode		2.56
Std. Deviation		.61981
Variance		.384
Range		2.97

5.3.4. Test for Normality

The Kolmogorov-Smirnov (KS) test to test for normal distribution indicated p = 0.597. As p >0.05, it can be assumed that the distribution is not significantly different from a normal distribution (table 5-11). IQ had a mean score of (2.39) and (0.62) standard deviation (σ) score.

Table 5-11 One-Sample Kolmogorov-Smirnov Test for Normality

		Mean IQ
N		202
Normal Parameters(a,b)	Mean	2.3852
	Std. Deviation	.61981
Most Extreme Differences	Absolute	.054
	Positive	.054
	Negative	-.030
Kolmogorov-Smirnov Z		.768
Asymp. Sig. (2-tailed)		.597

a Test distribution is Normal.

b Calculated from data

5.3.5. Survey Instrument Construct Analysis

As this study uses multiple variables to measure constructs of IQ dimensions, reliability tests were taken for each of the constructs. The set of target items must be consistent in their measurement of each construct (Nunnally 1978). The set of items must be reliable to the extent that they measure the construct they are meant to represent and produce reliable and consistent scores. Cronbach's α, one of the recommended measures of reliability testing, was used. The section of the survey that contained a set of target item questions to measure and evaluates accuracy, consistency and completeness (three dimensions of IQ) was evaluated separately with the following results. An α value (above 0.70) signals the sample items correlate well with the domain of items which it is intended to measure (Nunnally1978). Cronbach's coefficient α was calculated for accuracy, consistency and completeness constructs. It was found the Cronbach's α value for consistency construct fell well below 0.7. According to Churchill (1979) adjustment can be made to improve the α by removing some questions, therefore Q8 was removed, which increased the α

to 0.715. Cronbach's coefficient α value for the accuracy construct had α values of 0.714 and this suggested high reliability. Cronbach's α value for the completeness construct was 0.809, which showed very high reliability (table 5-12).

Table 5-12 Cronbach Alpha Values Accuracy, Consistency & Completeness

Construct	Reliability Statistics					
Accuracy	Cronbach's α	N of Items			N	%
	. 714	4	Cases	Valid	191	94.6
				Excluded(a)	11	5.4
				Total	202	100.0
Consistency	Cronbach's α	N of Items			N	%
	. 715	2	Cases	Valid	195	96.5
				Excluded(a)	7	3.5
				Total	202	100.0
Completeness	Cronbach's α	N of Items			N	%
	. 809	6	Cases	Valid	189	93.6
				Excluded(a)	13	6.4
				Total	202	100.0

5.3.6. Independent Sample t-tests on IQ

The t-test is the most commonly used method to evaluate the differences in means between two groups. Therefore t-tests were carried out on Irish and non-Irish respondents. Non-Irish respondents reported that documentation was more accurate in their workplace with a mean of 2.57 against Irish respondents with mean of 2.45. Irish respondents reported that documentation had more completeness in their workplace with a mean of 2.42 and Non-Irish respondents with a mean of 2.40. Once more Irish respondents reported that documentation was more consistent in their workplace with a mean 2.28 as opposed to Non-Irish respondents with a mean consistency of 2.2 (table 5-13).

Table 5-13 Descriptive statistics of Survey Participants Nationality

	Nationality	N	Mean	Std. Deviation	Std. Error Mean
Mean Accuracy	Irish	131	2.4599	.70221	.06135
	Non-Irish	67	2.5672	.55887	.06828
Mean Completeness	Irish	131	2.4168	.64712	.05654
	Non-Irish	67	2.3905	.55559	.06788
Mean Consistency	Irish	131	2.2824	.82065	.07170
	Non-Irish	67	2.2015	.73371	.08964

The t-test assumes that the data is normally distributed and that the variances are equal. The p-level reported with the t-test represented the probability of error involved in difference. The difference between Irish and non Irish was not found to be statistically significant (table 5-14) regarding accuracy, $p = 0.279$, $p > 0.05$, completeness, $p = 0.778$, $p > 0.05$, and consistency $p = 0.497$ $p > 0.05$.

As seen in table 5-15 respondents with 5-6 years experience reported that documentation was more accurate with a μ of 2.78, 3-4 years 2.36, 0-1 year 2.3, 2-3 years 2.26 and more than 7 years 2.7. Respondents with more than 7 years reported that documents were more complete with a μ of 2.65, 5-6 years 2.61, 2-3 years 2.27, 0-1 year 2.25, 3-4 years 2.17. Respondents with 5-6 years experience reported that documents were more consistent with a μ of 2.47, more than 7 years 2.43, 2-3 years 2.17, 3-4 years 2.05 and 0-1 year reported that documents were least consistent with μ of 2.02. This shows that respondents with 5-6 years experience said that documents were more accurate and more consistent while respondents with more than 7 years said documents were more complete.

		Levene's Test for Equality of variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI of Difference	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Mean Accuracy	Equal variances Assumed	5.790	.017	-1.086	196	.279	-.10724	. 09875	-.30198	.08750
	Equal variances not assumed			-1.168	161.992	.244	-.10724	. 09179	-.28850	.07402
Mean Completeness	Equal variances Assumed	1.122	.291	.283	196	.778	.02625	. 09279	-.15675	.20925
	Equal variances not assumed			.297	152.168	.767	.02625	. 08834	-.14828	.20078
Mean Consistency	Equal variances Assumed	1.292	.257	.680	196	.497	.08095	. 11902	-.15378	.31568
	Equal variances not assumed			.705	146.937	.482	.08095	. 11479	-.14589	.30779

Table 5-14 Independent Samples Test

Table 5-15 Group Statistics

	How long are you an employee with this organisation	N	Mean	Std. Deviation	Std. Error Mean
Mean Accuracy	0 -1 yr	17	2.3088	.57642	.13980
	2- 3 yrs	46	2.2591	.62884	.09272
	3-4 yrs	49	2.3588	.62110	.08873
	5-6 yrs	34	**2.7843**	.66354	.11380
	>7 yrs	53	2.6903	.63473	.08719
Mean Completeness	0-1 yr	17	2.2549	.69312	.16811
	2-3 yrs	46	2.2667	.54952	.08102
	3-4 yrs	49	2.1728	.53605	.07658
	5-6 yrs	34	2.6059	.70694	.12124
	>7 yrs	53	**2.6465**	.58017	.07969
Mean Consistency	0-1 yr	17	2.0294	.79982	.19398
	2-3 yrs	46	2.1739	.70881	.10451
	3-4 yrs	49	2.0510	.67888	.09698
	5-6 yrs	34	**2.4706**	.90404	.15504
	> 7 yrs	53	2.4340	.85506	.11745

5.3.7. Respondents IQ Perception

Participants opinions on the quality of information on documentation and participants' overall perception of IQ within the organisation are given in table 5-16.

Table 5-16 Participants Perception to IQ & Actual IQ

		Mean IQ	How would you rate the current quality of documented information in your department
Mean IQ	Pearson Correlation	1	-.213(**)
	Sig. (2-tailed)		003
	N	202	198
How would you rate the current quality of documented information in your department	Pearson Correlation	-.213(**)	1
	Sig. (2-tailed)	.003	
	N	198	198

** Correlation is significant at the 0. 01 level (2-tailed).

As this data collected in the survey is calculated with rating scales the correlations provided give general indications and not precise measurements. The following difference in the linear relationships between IQ reported in documentation and perception of the overall IQ within the organisation can be seen. IQ is negatively related with perception of IQ with a Parsons correlation coefficient of r = -0.213**, N = 198, p< 0.003. This means that as perception of IQ increases, actual perception of documentation IQ within the organisation decreases (significant at the .01 level (2-tailed)). The significance level shows that the correlations reported due to chance in the form of random sampling error is 0.003.

5.3.8. Hypothesis Testing

Six predictor variables underpinning this research were examined by a series of multiple regression analyses: one of the most widely employed multivariate techniques used in quantitative research to test the main-effect hypotheses. Stepwise regression has been shown occasionally to omit predictors from the model that would have produced statistically significant results with other

regression techniques therefore, in each case 'enter' multiple regressions analysis was conducted to determine predictors of IQ. Residuals analysis was conducted in each case to determine whether there were systematic violations of the assumptions of multivariate linearity, normality and homoscedasticity. Each beta coefficient (β) represents the standardized weighted contribution of a particular independent variable in predicting the value of a dependent variable (Mertler & Vannatta 2005). The ANOVA tests the significance of each of the models to see if the regression predicted by the independent variable explains the significant amount of the variance in the dependent variable.

Hypothesis 2

Conscientiousness will be associated with improved IQ. The independent variables associated with this hypothesis include dutifulness, achievement striving, self-efficacy and self-discipline which represent the statistical mean of the variables for conscientiousness. The dependent variables are completeness, consistency and accuracy, which represent the statistical mean of the variables for IQ. To evaluate H2, multiple regressions were conducted to determine if trainee characteristics were a predictor of IQ. The result shows regression coefficient ($R = .512$, $p < .01$) and R^2 shows that 26.2 percent of the variances was accounted for by conscientiousness (the predictor variable) see table 5-17. This suggests that conscientiousness has a rather large impact on IQ and accounts for much of the variance.

Table 5-17 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.512(a)	.262	.185	.56317

Model: $F(16,152) = 3.380$; $p < .001$. Hence the results of the multiple regression analysis are accepted as tenable, see table 5-18. Beta weights for all the predictors are significant at $p<0.001$.

Table 5-18 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.154	16	1.072	3.380	.000(a)
	Residual	48.208	152	.317		
	Total	65.362	168			

Hypothesis 3

Training design will be associated with improved IQ. The independent variables in this hypothesis are: training duration, training intervals, percentage of information quality training days, training programs and perception of effectiveness of training, which represent the statistical mean of the variables for training. The dependent variables are completeness, consistency and accuracy, which represent the statistical mean of the variables for IQ. To evaluate H1, multiple regressions were conducted to determine if training design was a predictor of IQ. The result shows regression coefficient ($R = .424$, $p < .001$) and r^2 shows that 17.9 % of the variances accounted by training design (the predictor variable) see table 5-19.

Table 5-19 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.424(a)	.179	.146	.55142

Model: $F(7,174) = 5.437$; $p<.001$ Hence the results of the multiple regression analysis are accepted as tenable and the null hypothesis H_0 is rejected (table 5-20). Beta weights for all the predictors are significant at $p<0.001$. This is suggestive that training design also has a significant impact on IQ and accounting for a large percentage of the variance in IQ.

Table 5-20 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.572	7	1.653	5.437	.000(a)
	Residual	52.908	174	.304		
	Total	64.480	181			

Hypothesis 4

Work environment will be associated with improved IQ. To evaluate H4, multiple regressions were conducted to determine if the work environment was a predictor of IQ. From the model summary table (table 5-21) work environment was seen to be a predictor of IQ. The result shows regression coefficient ($R = .289$, $p < .01$) and R^2 shows that 8.3 percent of the variances accounted for by the work environment (the predictor variable).

Table 5-21 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.289(a)	.083	.059	.59226

Model: $F(5,191) = 3.479$; $p < .01$. Hence the results of the multiple regression analysis are accepted as tenable and the null hypothesis H_0 is rejected (table 5-22). Beta weights for all the predictors are significant at $p<0.001$. These statistics show that the work environment has a moderate impact on IQ but only accounts for a much smaller variance.

Table 5-22 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.102	5	1.220	3.479	.005(a)
	Residual	66.996	191	.351		
	Total	73.098	196			

Hypothesis 5

Experience will be associated with improved IQ. To evaluate H5, multiple regressions were conducted to determine if experience was a predictor of IQ. From the model summary (table 5-23) experience was deemed to be a predictor of IQ. The result shows regression coefficient ($R = .269$, $p < .001$) and r^2 shows that 7.2 percent of the variances accounted for by Experience (the predictor variable).

Table 5-23 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.269(a)	.072	.068	.59785

Model: F (1,197) = 15.340; p< .001. Hence the results of the multiple regression analysis are accepted as tenable and the null hypothesis H_0 is rejected (table 5-24). Beta weights for predictors are significant at p<0.001. Work experience has a much smaller impact on IQ variance as it accounts for a smaller amount of the IQ variance.

Table 5-24 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5.483	1	5.483	15.340	.000(a)
	Residual	70.412	197	.357		
	Total	75.895	198			

Recording experience impacts IQ documentation. To evaluate this statement multiple regressions were conducted to discover if the recording experience was a predictor of IQ. From the model summary (table 5-25**)** recording experience was a predictor of IQ. The result shows regression coefficient ($R = .231$, $p < .001$) and r^2 shows that 5.3 percent of the variances accounted for by documentation experience (the predictor variable).

Table 5-25 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.231(a)	.053	.044	.60272

Model: F (2,197) = 5.532; p<.01. Therefore the results of the multiple regression analysis are accepted as tenable and the null hypothesis H_0 is rejected (table 5-26). Beta weights for all the predictors are significant at p<0.001. This suggests that documentation experience has a small impact on IQ and accounts for a much smaller amount of the variance in IQ.

Table 5-26 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4.019	2	2.010	5.532	.005(a)
	Residual	71.565	197	.363		
	Total	75.585	199			

Hypothesis 6

Perception of the importance of IQ will be associated with improved IQ. To evaluate this statement multiple regressions were conducted to determine if perception of IQ was a predictor of IQ. From the model summary (table 5-27) perception of importance of IQ was a predictor of IQ. The result shows regression coefficient (R = .229, p < .05) and r^2 shows that 5.3 percent of the variances accounted for by perception of importance of IQ (the predictor variable).

Table 5-27 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.229(a)	.053	.037	.61327

Model: F (3,187) = 3.457; p<.05. Hence the results of the multiple regression analysis are accepted as tenable and the null hypothesis H_0 is rejected table (5-28). Beta weights for all the predictors are significant at p<0.001. It would appear that perception of IQ importance does not have as big an impact on the variance of IQ as does conscientiousness and training design. Nevertheless it is still an important predictor of IQ.

Table 5-28 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3.901	3	1.300	3.457	.018(a)
	Residual	70.331	187	.376		
	Total	74.232	190			

5.4. Key Findings

This section gives a synopsis of the key findings from the survey which assisted in the development of the Information Quality Training Analysis Guideline discussed in Chapter 6. Findings from the survey instrument data collection suggested predictor capabilities of varying degrees between training and IQ, work environment factors and IQ, trainee characteristics and IQ; training design and IQ, perceptions of IQ importance and IQ and experience and IQ.

The majority of respondents were female and geographically, most respondents were Irish. The largest group of survey respondents had more than seven years experience. Of the total respondents, nurses accounted for 77%, doctors 9%, administration staff 7% and other participants 7%.

Non-Irish respondents reported that documentation was more accurate, whereas the Irish respondents reported that documentation was more

consistent and better completeness levels. However, these findings were not found to be statistically significant (NS).

Respondents with 5-6 years experience reported that documentation was more accurate and more consistent, and respondents with more than 7 years reported that documents were more complete. IQ is negatively correlated with perception of IQ.

Conscientiousness accounts for 26.2 percent of the variances Beta weights for all the predictors are significant at $p<0.001$. Experience accounts for 7.2 percent of the variances Beta weights for all predictors are significant at $p<0.001$. Work environment accounts for 8.3 percent of the variances Beta weights for predictors are significant at $p<0.001$. IQ perception accounts for 5.3 percent of the variances Beta weights for all predictors are significant at $p<0.001$. Training design and sequencing accounts for 17.9 percent of the variances Beta weights for all predictors are significant at $p<.001$.

5.5 Summary

This chapter outlined the development of a questionnaire that was specifically designed to measure IQ predictors and then explored through a quantitative analysis to show that IQ outcomes could be predicted by trainee characteristics (conscientiousness), training design, sequencing, elements of the work environment, importance of IQ perception and documentation recording experience. Adaptations of Baldwin & Ford's (1988) transfer of training model were used for developing the IQ conceptual model for this study. The web based survey was administered to a sample of healthcare professionals: nurses, physicians, administration staff, clerks and laboratory technicians.

A range of data analysis methods were employed on the data. The values were calculated as the statistical mean of the items associated with each group.

Analysis included demographic information, response analysis, descriptive statistics, screening for normal distribution, construct analysis, independent sample t-tests, multiple regression, and correlation analysis. All hypotheses were tested using multiple regressions. The KS test indicated a normal distribution. The set of items used to measure IQ was shown to be reliable to the extent that they measured the construct they are meant to represent and produced reliable and consistent scores.

The results show that training, work environment, experience, perception of IQ importance, documentation recording experience, and conscientiousness are all predictors of IQ. Support was found for all the main-effect hypotheses. However, there are some other unknown predictors that account for the remaining variance which have not been identified in this study. The results of this survey points to the importance of examining IQ from a broader perspective and valuable in identifying work environmental factors, trainee characteristic (conscientiousness), the training design and experience as predictors of IQ in order to incorporate these constructs in the development of an Information Quality Training Analysis Guideline for the design of Information Quality Training Plans presented in Chapter 6.

The questionnaire was suitable for gathering reliable subjective measures, such as user perception of IQ, training, work environment and trainee characteristics, and also useful as a confirmation tool to corroborate the results of the experiment. Questions were designed to gather quantitative data and carefully crafted, as much as possible, to avoid ambiguities. However, a limitation of the study was that once the questionnaire was administered to the sample population, control over the environment was limited. This loss of control meant the validity of the results was more reliant on the honesty of the respondent. Thus, it is more difficult to claim complete objectivity with the questionnaire data than with the results of the controlled laboratory experiment.

Chapter 6

INFORMATION QUALITY TRAINING REQUIREMENTS ANALYSIS GUIDELINE

6.1. Introduction

This chapter outlines the construction of the Information Quality (IQ) conceptual model (figure 6-1) and the design of an Information Quality Training Requirements Analysis Guideline (IQTRAG) as a Design Science (DS), problem-solving activity for improving IQ problems highlighted in studies describing frequency, type, and clinical importance of hospital patient admission records detailed in Chapter 1. IQ predictors identified in Chapter 4 and Chapter 5 provide key content elements for the design of the IQTRAG.

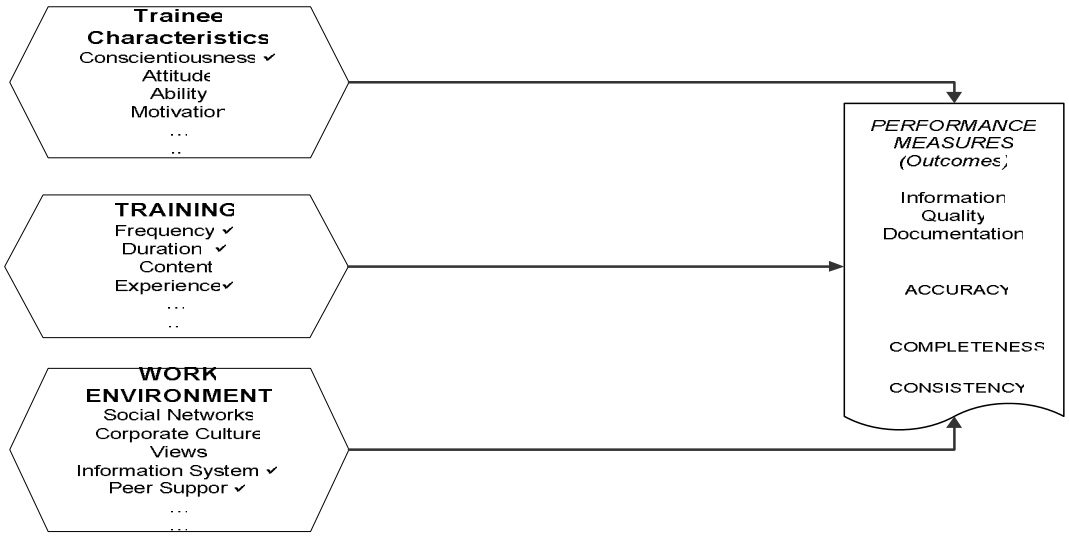


Figure 6-1 IQ Predictors

The DS approach used to create an artefact (IQTRAG) involved 'Method Engineering'. Method engineering consists of a 'Role' (in this case the researcher) who is responsible for an 'Activity' (identifying IQ training needs), which provides a 'Result Document' (IQTRAG) that is defined by a set of 'Techniques' (questionnaire, experiment and group interviews), using a set of 'Tools' (Survey Monkey, group interviews and laboratory experiment) (figure 6-2).

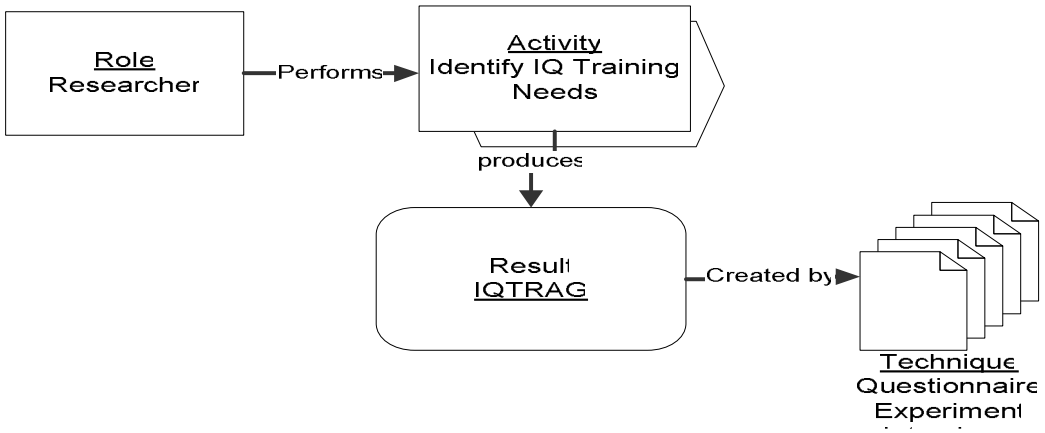


Figure 6-2 Method Engineering Example

The Generic guideline was investigated by means of the mixed method approach, and instantiated in a given domain specific application context (healthcare) to define a task specific rational process (patient admittance form) for assessing IQ training needs (IQ dimensions), and to assess IQ documentation performance measures (outcomes) using three dimensions of IQ (accuracy, consistency and completeness), (see figure 6-3).

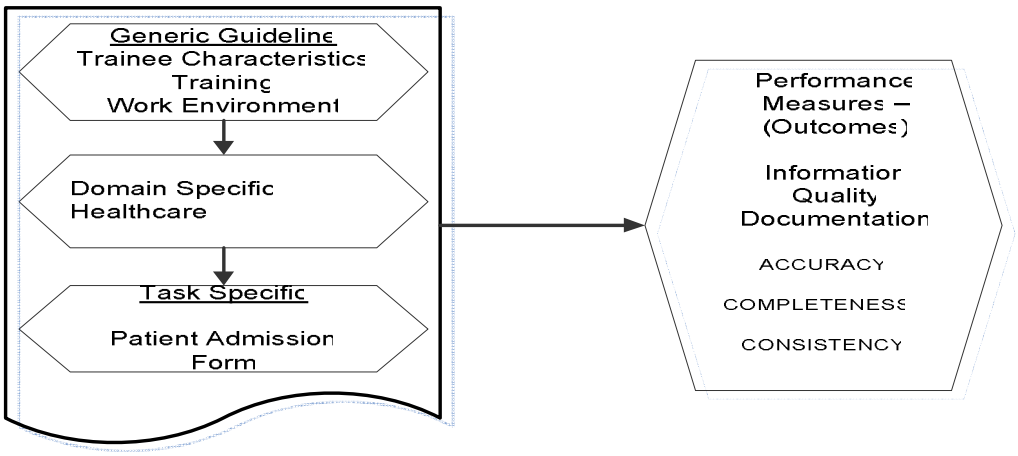


Figure 6-3 Generic Conceptual Model

6.2. Construction of the Conceptual Model

Analysis from the group discussions and laboratory experiment findings discussed in Chapter 4, suggest that training design, trainee characteristics and the work environment were important predictors of IQ. In addition, the IQ and training literature presented in Chapter 2 supports the notion that a conceptual model for identifying predictors of IQ is neglected in these studies. Therefore to develop an appropriate IQ predictor model, the most relevant literature was searched firstly for the most common training models, and secondly for an instrument for measuring trainee characteristics. It was also important to determine whether a subjective instrument for IQ measurement had been established. From the training literature it was noted that the framework of Baldwin & Ford (1988) attracted many empirical studies, which examine how individual characteristics, job attitudes and work environment affect transfer of training (Baldwin & Ford 1988; Tannenbaum et al. 1991; Martocchio 1992; Mathieu & Saks 1995; Tracey et al. 1995; Facteau 1995).

Therefore, Baldwin and Ford's framework was adapted and extended to incorporate IQ dimensions in developing an IQ predictor model. This IQ

predictor model is unique in four ways: 1) it establishes training, work environment and trainees' characteristics as predictor variables of IQ; 2) it is studied in a specific domain (healthcare); 3) predictors are confirmed within a specific task (patient admission form), and 4) it implements all these constructs to find their predictor capabilities on three dimensions of IQ (accuracy, completeness and consistency). Trainee characteristics' impacts on IQ was measured on the constructs of self-discipline, dutifulness, self-efficacy and achievement striving. The work environment impact on IQ was measured by the type of IS in operation (paper based or electronic form), admission form layout (free style or tick box), and peer support. Training design impact on IQ was measured on training duration, training intervals, documentation recording experience, and trainees' perception of IQ.

6.3. Training Plan

The basic IQTRAG for identifying elements of Information Quality Training Plans (IQTPs) apply whether the Information Quality Training (IQT) consists of a training programme, course, or module. This guideline is designed to guide those involved in IQT in a wide variety of settings - training centres, companies and other training sites. This guideline shows the general structure of IQT designed to meet predefined IQ objectives. Preparing an IQTP is a process of determining the content and sequencing of IQT units in order to provide direction to learning and map it against IQ indicators which can be evaluated at any given time. This IQTRAG is designed to promote or improve IQT and sets out the minimum requirements to be addressed when preparing an IQTP.

6.4. Guideline Contents

Developing an IQTP includes a number of stages.

Stage 1**:** Set goals and objectives for the Training Plan. What is the aim of the training program? Each of the objectives should be mapped to a specific IQ unit of learning (e.g., accuracy, consistency, and completeness are important and necessary elements for improvement as seen in the medical error studies in Chapter 1, and supported by the experimental findings in Chapter 4, and the survey findings in Chapter 5). Therefore the objective in this case may be to improve accuracy consistency and completeness of documentation of admission data forms.

a) Set realistic measurements for each objective (set up metrics to measure each of the objectives identified in stage 1 (see IQ measurements, Chapter 2).
b) Identify the IQ trainee audience (Who needs to be trained: e.g., nurses, doctors, administration staff, laboratory staff, other).

Stage 2: Identify IQT requirements: (What dimensions of IQ needs training? (e.g., accuracy, see Findings: Chapter 4).

Stage 3: Budget Analysis (Cost implications needs to be considered, and although this stage is most important, it is outside the scope of this study).

Stage 4: Development approach. Each identified module should be defined as units of IQ learning and a detailed statement of the main IQ components should be outlined.

a) Assess trainee characteristics (This variable has shown to be an important predictor of IQ performance (see Findings: Chapter 5).
b) Identify training sources.
c) Duration (What is the most effective length of training sessions that suit the trainee for best performance results?).

d) Determine IQ unit training sequencing (How will the sequencing of training programs be best scheduled to suit the learning styles of the trainee? see Chapter 5).
e) Determine schedule.
f) Identify training aids and training materials.
g) Determine delivery mode of training modules and class size.

Stage 5: Evaluation criteria**:** evaluate IQ training effectiveness (how well did the training program work?); trainer's ability to transfer required knowledge to trainees (How well did the trainer impart the knowledge to the trainees); trainee learning (how well did the trainee learn the skill?); and trainees' performance (how well did the trainee transfer the learned skill knowledge to the work place?)

Stage 6: Review Process**:** Review training plan and contentiously update.

Activity 1: Scope

Identify the scope of the IQT in terms of training goals. One technique of refining training scope is by the construction of (a result document) an 'error log' (table 6-1), where IQ problems can be identified by its IQ dimension or by an 'information map' (figure 6-4) where the magnitude of errors in records can be recorded.

Table 61 Error Log

Problem Identification Sheet				
Patient No	# Accuracy Errors	# Consistency Errors	# Completeness Errors	# … Errors
1				
2				

An Information map (result document) is a document that is derived from an analysis of activities/tasks carried out in an organization. It is possible (figure 6-4) for the Quality Control Manager (*role*) to gather error information (*activity*) and create an information map (*result document*) using questionnaires (*techniques*).

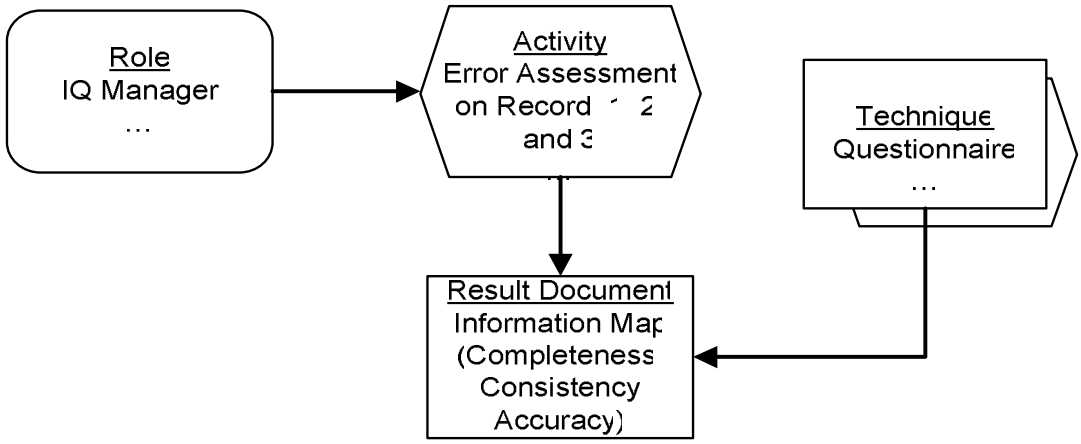
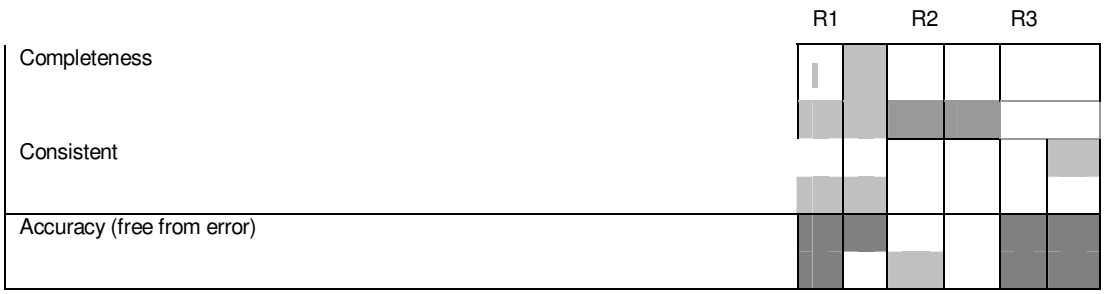


Figure 6-4 Error Assessment using an Information Map

An I*nformation map* (table 6-2) can be created from errors in specific records where the data is sourced (*R1- R2 and R3 etc. where R1 is record one, R2 is record 2 and R3 is record 3.* Analysis of this information shows that R1 had 25 percent completeness (as presented by the white block), 50 percent consistency and 25 percent accuracy; R2 had 50 percent completeness, 100 percent consistency and 75 percent accuracy, and R3 had 100 percent completeness, 75 percent consistency and 0 percent accuracy.

Table 6-2 Information Map

Information Map created by IQ manager on records R1, R2, and R3



Goals and Objectives

Determine the goal of what you are trying to accomplish (e.g., to improve information quality accuracy, completeness, and consistency of documented information). The Objectives of the IQTP needs to be understood, therefore, it is necessary to describe the level of poor IQ that staff have encountered in patient records on a daily basis, under each of the IQ dimensions (table 6-2).

Table 6-3 IQ Documentation Assessment

Employee Name	Department	Role	IQ Dimension			
			Accuracy	Consistency	Completeness	…

Set realistic measurements (metrics) for each objective (how are you going to measure the IQ improvement? see example in table 6.4 taken from the IQ literature).

Table 6-4 Information Quality Metrics Classification

Dimension	Metric	Definition and Measurement Parameters
Accuracy	# correct values / # total values	The measure or degree of agreement between a data value and the source agreed to be correct
Consistency	# consistency / # Total	The extent where the physical instance is in accordance with the specified format
Completeness	# incomplete items / # total items	The extent to which data elements are not missing

Identify Audience

Who are you training? Describe the intended audience**(**s) for the training plan. This may be broken down by role or department units (table 6-5**)**.

Table 6-5 User Identification

Role	Department

Activity 2: Training Requirements

Training needs can be identified by a needs and skills analysis.

Needs and Skills Analysis

This section provides a broad overview of the steps in a needs assessment and the reasoning for implementing one. The needs assessment will help determine content (figure 6-5): identify the target audiences for each course module and assess the training needs for each target audience identified. A questionnaire table 6-6, 6-7, 6-8, and 6-9 may be used to gather needs requirements information. Identification of the 'problem areas will determine type of training, duration and extent of training.

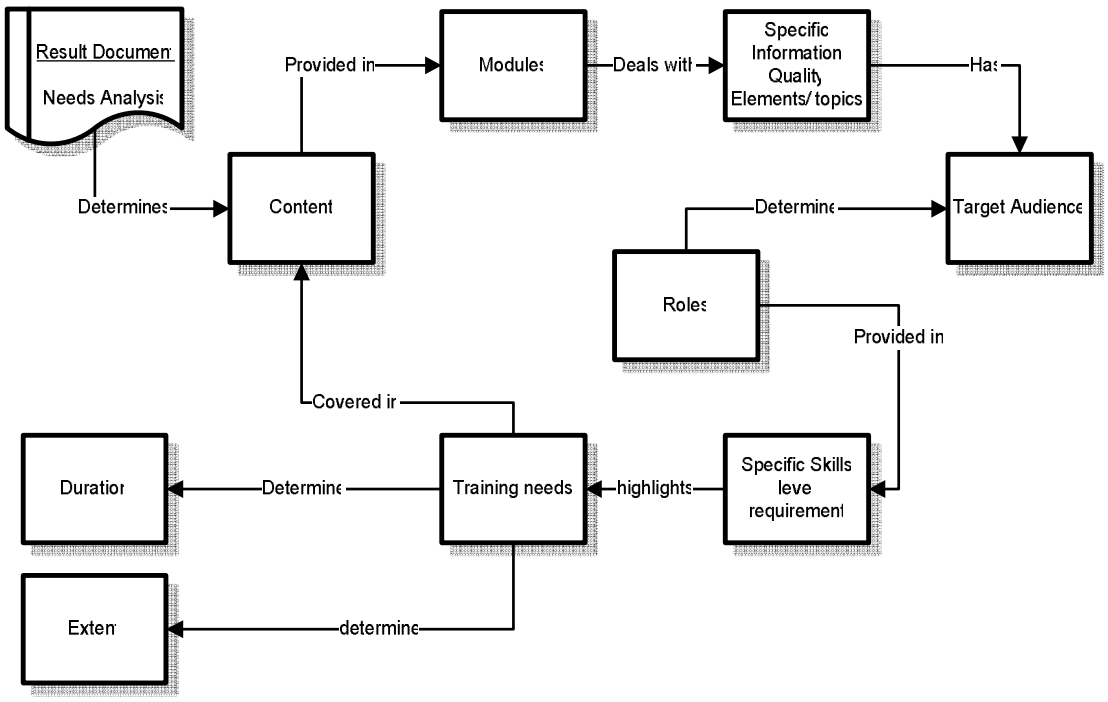


Figure 6-5 Needs Assessment Determines Content

Table 6-6 IQ Required Training by Criticality Criteria

Job Title	Name					Department	Training Required	
IQ Dimension	Error Frequency					Importance of Good IQ to task	Yes	No
	Never	Seldom	Sometimes	Usually	Always	Criticality 1 2 3 4 5		
Accuracy						Criticality 1 2 3 4 5		
Consistency						Criticality 1 2 3 4 5		
Completeness								

Table 6-7 IQ Needs Assessment

Employee Name:		**Title:**			
Completeness	Never	Seldom	Sometimes	Usually	Always
How often do you find patient identification number (MRN) not filled in?					
How often do you find incomplete patient histories?					
How often do you find patient admission forms not signed by admission staff?					
How often do you find that the patient's Date of Birth (DOB) missing?					
How often do you have to fill in missing Information that should have been recorded?					
How often do you find the patient's address not recorded fully?					
Consistency					
How often do you find date of admission not filled in the standard (required) format?					
How often do you find patient Date of Birth (DOB) written in a non consistent format?					
How often do you find patient's weight recorded in the correct format?					
Accuracy					
How often do you find typographic errors(misspelling) in a patient file?					
How often do you find the Patient's identification number (MRN) recorded inaccurately?					
How often do you need to make corrections to incorrect information recorded by colleagues?					
How often do you find patient's Date of Birth (DOB) not accurately recorded?					

Table 6-8 Assessment of the Work Environment

Work Environment		
Form layout	☐ Free style	☐ Tick box
Good Peer support	☐ Yes	☐ No
Information System	☐ Electronic	☐ Paper based

Table 6-9 Training Assessment Form

Complete this assessment, using the following scale: **1** = *Needs Work (Unsatisfactory)* **2** = *Gets By* (*Marginal)* **3** = *Meets Requirements* **4** = *Exceeds Requirements* **5** = *Exceptional*					
Which of the following areas do you think would improve from further specific training	☐ All	☐ Accuracy	☐ Completeness	☐ Consistency	☐ None
The time I spent recording patient information relative to other duties is	☐ 0%	☐ 1- 25%	☐ 26-50%	☐ 51-75%	☐ 76- 100%
The frequency of which I record patient information is:	☐ Never	☐ Seldom	☐ Occasionally	☐ Often	☐ Very Often
I feel the consequence of recording inaccurate information in Patient Forms is	☐ Negligible	☐ Low	☐ Moderate	☐ High	☐ Very High
I feel the consequence of incompleteness of information in Patient Forms is	☐ Negligible	☐ Low	☐ Moderate	☐ High	☐ Very High
I feel the consequence of not recording consistent information in Patient Forms is	☐ Negligible	☐ Low	☐ Moderate	☐ High	☐ Very High

Activity 3: Budget

Training plans must take into account feasibility; cost of training etc. (this is outside the scope of this study)

Activity 4: Development Approach

This section discusses the activities, techniques and tools used to develop the course curriculum and for identifying the materials required for the TP. The IQ modules or units should relate to the IQ needs identified in the needs and 'skills analysis' table 6-6, 6-7, 6-8, and 6-9, and should take into account factors such as course objectives, the target audience, enrolment, training aids, venue, trainers, schedule, participant feedback, performance review, trainer review, training plan evaluation and costs (some of which are outside the scope of this study).

Activity 4.1: Identify Information Elements

Table 6-10 provides a template of IQ dimensions that should be considered when identifying the information elements for training, setting out the measurements used and the information gathering techniques such as survey or interview.

Table 6-10 Information Quality Dimensions

IQ Dimensions	Measurement	Technique	Document	Training	
				Y	N
Accessibility					
Believability					
Completeness					
Consistent representation					
Ease of manipulation					
Free from error					
Relevancy					
Timeliness					

Activity 4.2: Training Sources

Describe the training provider. Training may be internal (course developed in-house) or external (contracted to external training agencies).

Activity 4.3: Set Training Program Activities

Outline of training plan activities see checklist (table 6-11).

Table 6-11 Training Plan Activities

Sequence	Activity
	Complete Skills Assessment
	Define class size by module
	Identify training elements
	Develop course designs
	Develop training material
	Set Curriculum
	Develop Evaluation Plan
	Check feasibility
	Run pilot study
	Evaluate and update training plan
	Deliver training
	Identify training program success factors
	Execute Evaluation
	Review feedback

Activity 4.4: Identify Class Size

Outline the number of trainees per session.

Activity 4.5: Facilities

Type of training and method of delivery will help to determine the physical facilities needed for the training. The physical facilities in turn will determine the location of the training. Size of training class will determine the venue.

Activity 4.6: Identify Training Staff

Identify the trainer(s) who will deliver the training course.

Activity 4.7: Identify Training Materials

This section describes the training resources required by both instructors (to prepare the training program) and participants for the training course. This may include hardware, software and training materials.

Activity 4.8: Delivery

This section describes how training can be delivered, e.g. in a class-room environment, web-based sessions, workshops, seminars, lectures etc. One or more methods of instruction may be used for example, lectures/classroom environment may be better when the aim is to impart knowledge, and demonstrations may be better if the aim is to teach skills, and a combination of both if the aim is to impart knowledge with the view to teach a new or complex skill.

Activity 4.9: Training Schedule

Describe the type of training (classroom) and the training schedule (duration, location, and dates). Other factors include details of the training facilities, access to networks, and security clearance and physical access to buildings etc. Provide a description of the components that make up each course.

Each course may comprise of one or more modules. A course description should be developed for each module. At a minimum, each course description should include the course/module name; time; class size; the target audience; course objectives; module content; specific training resources required such as devices, aids, equipment, materials, and media to be used (table 6-12 and 6-13).

Table 6-12 Training Topics

Training Topics			
Training Manager:----------Researcher		Course Title: -------	
Module	**Approach**	**Resource**	**Start Date**
IQ Principles	Lecture		
IQ Concepts	Lecture		
Induction	Workshop		
Legal Issues and IQ	Workshop		
Financial Issues and IQ	Workshop		

Table 6-13 Training Curriculum

Training Curriculum				
Instructor Name	Module	Course Title		Date
Audience	Class Size	Location	Delivery	Day: [X] of [Y]
Setup Requirements: e. g. flip charts, PCs, monitors				
Session Name	Time	Objectives		
Topic #1				
Coffee Break				
Topic #3				
Topic #4				
Lunch Break				
Topic #4				
Topic #5				
Total Time				

Activity 5: Training Evaluation

Describes how training evaluation can be performed. Identify the methods tools, forms and metrics that will be used to perform the evaluation of training effectiveness table 6-14; evaluation table 6-15, and trainer performance table 6-16.

Activity 5.1: Trainee Evaluation

Table 6-14 Trainee Assessment Form

Trainee Assessment Form					
Instructor Name:		Course Title:			
Rate trainee's mastery of assignment	Failure	Poor	Average	Superior	Excellent
Trainee's Name	**1**	**2**	**3**	**4**	**5**

Activity 5.2: Trainer Evaluation

Describe how the course may be revised, modified and updated to enhance the course materials and structure in the future, based on feedback following the evaluation process. One source of feedback could be a course or instructor evaluation form (table 6-15 and 6-16).

Table 6-15 Acceptable Criteria & Measurement

Criteria	Measurement
Course	Successful or unsuccessful
Usefulness of training Session	Agree or Disagree
Rank the instructor's Knowledge	Scale 1-5
Subject or topic	Relevant – not relevant
Covering the subject	Poor, fair, satisfactory, good excellent
Quality of presentation	Poor, fair, satisfactory, good excellent
Usefulness of Topic	Very low, Low moderate, high very high

Table 6-16 Training Course Evaluation Form

Training Course Evaluation Form					
Employee Name:		Course Title:			
Trainer:		Training Company:			
Instructor:	**Excellent**	**Very Good**	**Good**	**Fair**	**Poor**
Knowledge of subject matter					
Listening skills					
Presentation skills/delivery					
Overall instructor rating					
Topics covered in too much detail					
Course Content:					
Course achieved its objectives					
Exercises					
Use of class time					
Overall Content rating					
Materials:					
Overall course materials quality					
Potential value as future reference material					
Value of materials presentation					
Flow/structure of information					

Activity 5.3: Training Evaluation

Gather trainee reactions on the following topics: scope and relevance of course, appropriateness of objectives, usefulness of assignments and materials, effectiveness of course training materials, adequacy of the facilities, timing or length of the course, effectiveness of the instructor(s). The objectives of the training program may be evaluated and measured by checking the error log of patient's records before and after the training

Activity 6: Reviewing

Review training plans for improvement. This information can include updating course contents, modification to training environment and other changes that indicate additional training. Reviewers should cover three areas firstly people with expertise in content who review the TP to verify completeness and report

sensibility; secondly experts in IQ field who review the method by which the training plan is developed and report its validity and finally potential users of the TP to judge its usefulness and provide feedback.

6.5. Guideline Validation

The issue of validity was addressed by eliciting the views of IQ experts and medical professionals, and by using more than one method of data collection. Combining qualitative and quantitative approaches ensures the research has integrity and adequately measured what it intended to measure. Collection of information using a triangulated approach helps cancel the limitations of one method by the use of another and allow cross-checking of results to provide more reliable findings. Additionally, further investigation by qualitative methods (interviews) helps to fill gaps within the quantitative study. Figure 6-16 gives a Design Science approach to developing an information quality training plan.

6.6. Summary

From a review of medical errors discussed in Chapter 1, insight was gained into IQ problems in healthcare. By conducting interviews with healthcare practitioners the most problematic areas of IQ recording were identified and mapped to specific IQ dimensions. Medical professionals need to share a set of pre-existing patient information data sets. The data recording process and the task of accurately, completely and consistently recording patient information have been seen to pose many challenges: data recorded inaccurately, data recorded incompletely, and data recorded in an inconsistent format. In most cases, practitioners make decisions with the available information and use 'gut instinct' or experience to choose the correct course of action when data available does not match expectations. This course of action is complicated by evidence of medical errors in the media. Existing tools do

not appear to solve the problem and therefore it was important to devise a problem solution artefact IQTRAG to help deal with this problem as outlined in this chapter.

In the final chapter we give a brief overview of the study and its contribution to the literature and practitioners, together with its limitations and recommendations for further research.

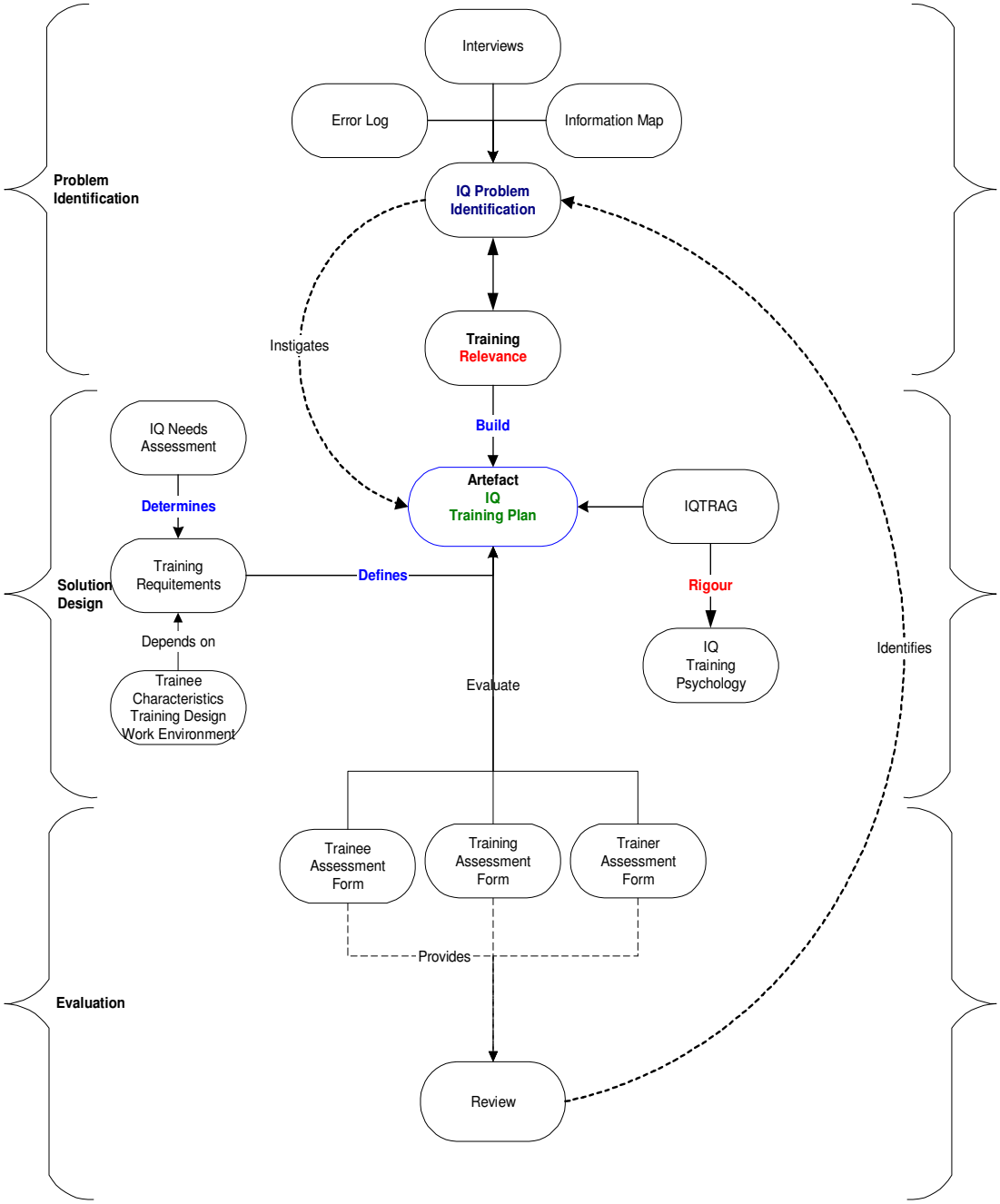


Figure 6-6 Design Science Approach to IQTP

Chapter 7

CONCLUSION

7.1. Introduction

There is considerable evidence to confirm that IQ problems in healthcare lead to loss of life and decreased quality of life. It also accounts for substantial economic losses. To date no attempt has been made to remedy these serious problems within the related literature which is devoid of conceptual models, or systematic investigation of key predictors of IQ. While there is a wealth of literature regarding training transfer models and typologies, there is a significant lack of studies, discussing the relationship between training, the work environment, IQ perception, experience, training design and trainee characteristics on IQ This research was therefore undertaken to fill this void. Its aim is to provide a DS Information Quality Training Requirements Analysis Guideline (roadmap) for IQ managers for the design of Information Quality Training Plans. The presented artefact (model) guarantees rigour and relevance of the guideline. Therefore, not only the use of this guideline for practitioners but also a contribution to the IQ knowledge base is achieved.

The objective of this research was to investigate predictors of IQ and provide an original and practical solution to poor IQ: Chapter 1 outlined the background to the research, and motivation for conduction this study. This section also outlined the hypothesis for investigation, research approach and contribution to the body of knowledge. Justification was highlighted in terms of lack of prior research on predictors of IQ.

Chapter 2 reviewed related work in the quality (section 2.1), information quality management (sections 2.2), information systems (sections 2.2.2) and training

literatures (sections 2.3), and gave an overview of the most commonly used IQ frameworks and training models (sections 2.4). It identified gaps in the body of knowledge (sections 2.5), which highlighted the significance of the chosen research area. The literature review revealed that no study to date has empirically examined key predictors of IQ, and this in turn led to six hypotheses for investigation**.**

Chapter 3 outlined and justified the appropriateness of a Design Science research methodology, which was deemed the most suitable process for investigating the research proposition 'If training is applied, information quality will increase in a way that will ultimately decrease medical errors in documentation'. It also detailed the philosophical stance and the research framework. Finally, ethical considerations of the research were addressed.

Chapter 4 provided a detailed account of the controlled laboratory experiment that was used in this study to support the first hypothesis. Sufficiently well specified tasks were supplied on predefined hospital scenarios. This section also provided results of the data analysis from 23 participation trainee student nurses, accompanied with analysis of the group interviews and discussions.

Chapter 5 outlined the Web based survey research phase where an involvement from practitioners was sought from practitioners in Irish hospitals. Thus, a better understanding of Information quality requirements in the business world was established. It analysed the data collected from a total of 202 valid responses. The chapter included testing of hypotheses that gave an insight into the relationships between the predictors and IQ.

Chapter 6 outlined the construction of the Information Quality Conceptual Model and the Information Quality Training Requirements Analysis Guideline (IQTRAG), as a Design Science (problem-solving activity) for improving IQ.

Conclusions from the research and the important specific contribution of this work are presented in this final chapter. The implications of this research for academia and practitioners are also highlighted in this section. The chapter concludes with a discussion on the limitations of the study and an identification of areas for further research.

7.2. Summary and Discussion of the Study

This study utilised a design science research process for conducting the study that combined qualitative and quantitative research methods to guide the overall research process (figure 7-1) The primary requirements on design science are rigour and relevance (Hevner et al. 2004). Rigour was ensured by applying suitable methodologies and frameworks. Relevance was ensured by feedback from the business environment.

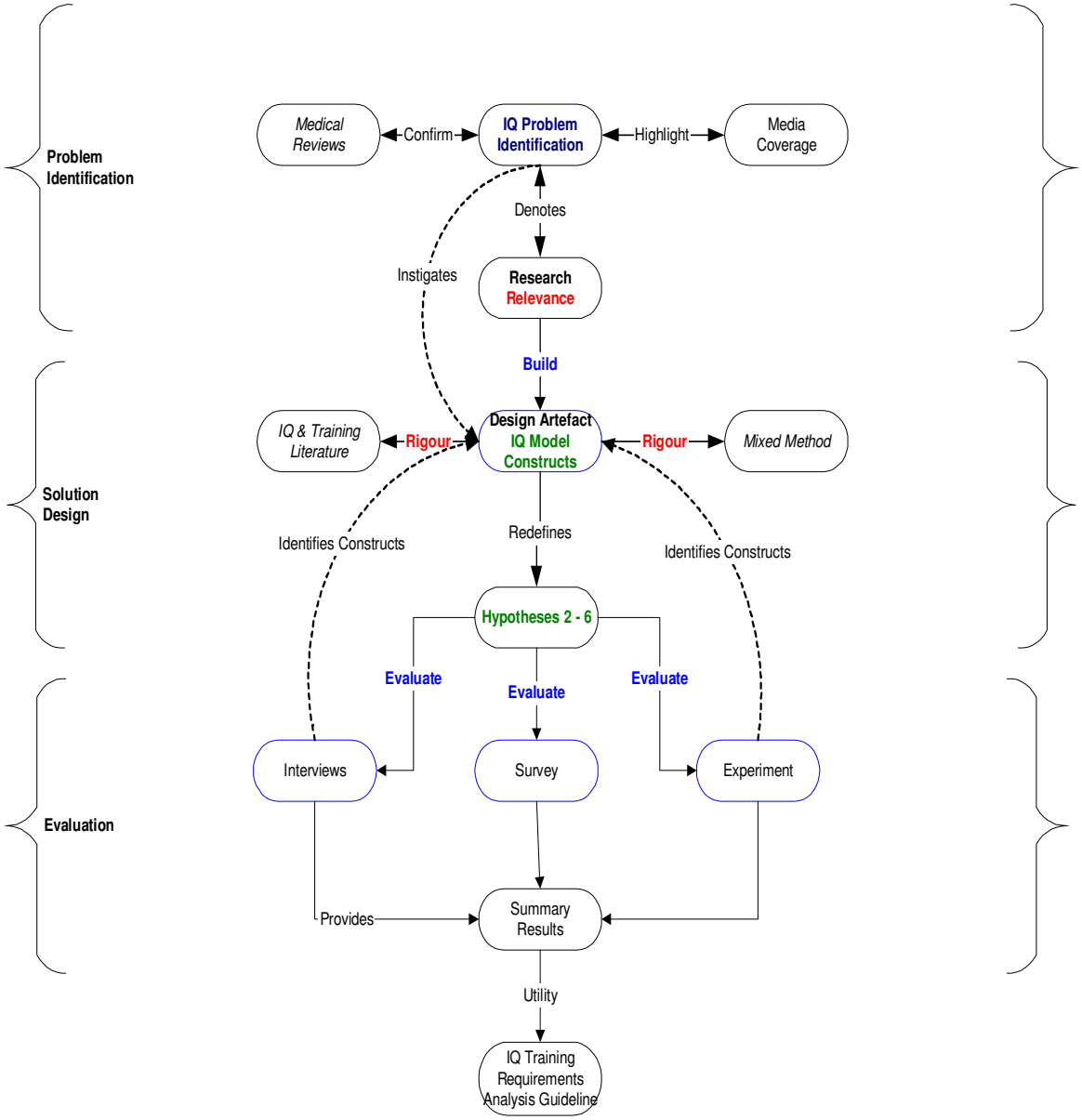


Figure-7-1 Design Science Research Process

According to Rosemann & Vessey (2008) in the first phase of a research process, a problem has to be identified that has practical relevance. This phase was divided into the following steps: 1) identify the problem: to identify the problem, a literature review was used where medical errors were mentioned in scientific publications and medical reports, and 2) pre-evaluation

of the precise relevance: to evaluate relevance, medical reports were consulted to assure practical relevance. The relevance was validated by medical reports; therefore, a solid and important foundation was laid for this study. As a result of this phase the research hypotheses were defined.

Once the problem was identified and a pre-evaluation on its relevance was conducted a general research proposition postulating a link between the solution space and the problem space was created as follows: 'If training (solution) is applied, information quality will increase in a way that will ultimately decrease medical errors in documentation'. A literature review revealed that the relationship between these constructs and IQ has not been, up now the subject of investigation.

The study was guided according to the suggested design science research process, making use of analytical, quantitative and qualitative methods derived from the IQ and training disciplines and linking them in a rigorous framework. Evaluation was achieved by the means of a laboratory experiment, interviews and practitioner web based survey. Therefore, after evaluation of the laboratory experiment results, interviews and group discussions, a Web based survey was completed to finish the evaluation stage.

In the second phase, the solution was designed. It was divided into two steps 1) artefact design and, 2) supporting literature research. After identifying a problem of poor IQ and pre-evaluating its relevance (medical errors), a solution was developed in the form of an artefact (conceptual IQ predictor model). Within this phase, research rigour was ensured by using all related work available in the development of the model.

This conceptual model was developed by extending Baldwin & Ford's (1988) model that had been developed to fill similar gaps in the training literature, which consisted of three primary lenses: the work environment, training design,

and trainee characteristics. The extended element is the inclusion of IQ dimensions. Any number of IQ relationships can be analyzed within the context of the IQ contextual model, which provides reference points for anchoring the analysis within both the IQ and the training literatures.

With respect to this study, six relationships under the umbrella of three broad categories: 1) training, 2) the work environment, and 3) trainee characteristics were investigated as outlined in 1–6 , The results of which provided a vehicle for developing a design science Information Quality Training Analysis Guideline as a problem based solution to poor IQ.

H1: Training will be associated with improved IQ.

H2: Conscientiousness will be associated with improved IQ.

H3: Training design will be associated with improved IQ.

H4: Work environment will be associated with improved IQ.

H5: Experience will be associated with improved IQ.

H6: Perception of the importance of IQ will be associated with improved IQ.

Analysis was done using well known statistics to ensured rigour. Results are summarised as follows and will be published in form of this PhD thesis, journals and conferences articles. There is also a possibility to publish individual results from each phase of this study.

Hypothesis 1: Training will be associated with improved IQ.

To find out what factors affect IQ it was necessary to examine the external factors identified in the training literature that have been found to impact on transfer of training to the work place. Therefore, after the analysis of the

experimental and group interview data (Chapter 4), a conceptual model of IQ predictors was developed and organised into three constructs: trainee characteristics, the work environment and, training design and sequencing, which are investigated in the following hypotheses.

Hypothesis 2: Conscientiousness will be associated with improved IQ.

Chapter 5, details the extent that trainee characteristics has with respect to job performance. From our analysis of the survey data it is clear that the trainee characteristics (such as conscientiousness) is one of the most important predictors of IQ accounting for 26 percent of the IQ variance.

Hypothesis 3: Training design will be associated with improved IQ.

From our analysis of the survey data, training design (such as duration and sequencing) accounts for 18 percent of the IQ variance and therefore, is also an important predictor of IQ,

Hypothesis 4: Work environment will be associated with improved IQ.

The work environment was identified from the observational study and group interviews, and then further tested using the Web based survey sent to Irish hospitals. Findings supported this hypothesis (the work environment provided 8 percent impact on IQ).

Hypothesis 5: Experience will be associated with improved IQ.

This hypothesis was also supported accounting for 7 percent of the variance in IQ,

Hypothesis 6: Perception of the importance of IQ will be associated with improved IQ.

The difference between IQ perception and actual IQ recording was made clear. The participants reported that there was a high degree of IQ within their organisation, however, the errors they reported in the documentation was contradictory. The result showed a sizable breach between perception of IQ and the actual IQ, which indicated that although employees are aware of the importance of good IQ, the transfer of this knowledge in practice to the workplace failed. However, IQ perception of employees proved to also be a key predictor of IQ but only accounting for 5 percent of the IQ variance.

From this overview it is now possible to address the principal research proposition:

> *'If systematic training is applied, information quality will increase in a way that will ultimately decrease medical errors in documentation'.*

The findings of the survey, experiment, interviews and discussions provided a solution to this problem by developing an Information Quality Training Requirements Analysis Guideline (Chapter 6), which incorporated the identified predictors of IQ, and is the final research output of this study. The literature review of Chapter 2 concluded that there was a gap in the previous research relating to predictors of IQ. Since there were no studies in the literature that identified important predictors of IQ, the first (exploratory) stage of the research was to list possible key predictors that may influence IQ. Subsequently, these predictors categories were identified supported by group interviews and discussions and were then incorporated into a conceptual IQ predictor model for further analysis and testing through a Web based survey so that their impact could be analysed. The analysis of these predictors' impact suggested

the need to incorporate their importance into the development of the Information Quality Training Requirements Analysis Guideline artefact detailed in chapter 6. Following the design science guideline 7, the complete results will be published in the form of this PhD thesis.

This section presents the conclusions formed from analysis of the data collected, and presented, in Chapter 4 and Chapter 5. Each hypothesis was discussed concisely above. This analysis provided an insight into the relationships between many external influencing factors and how they impact on IQ. In the experiment in which we investigated H1, training had an effect on accuracy as there was a statistically significant improvement between groups. However, there was a non-significant statistical result for both completeness and consistency. Despite this, support was found for hypotheses H2, H3, H4, H5, and H6 with varying impacts on IQ, within the survey findings.

Additionally, perception of IQ within the organisation and the actual IQ reported in documentation regarding accuracy, completeness and consistency posed many questions as to the actual awareness IQ in general and is suggestive of the need for IQ training at the most basic level.

Since many of the medical errors in healthcare relate to IQ dimensions, it is reasonable to expect that the implementation of training in IQ would adequately address this problem. However, the effects of just implementing training seem to be less important than the analysis of trainee characteristics which has the largest impact on IQ in the context of this study. Relying on our findings, we suggest that training managers need to consider many factors, when implementing an IQ training program; trainee characteristics, work environment, training design, perception of IQ importance, and experience, to ensure better IQ. In summary, this research *found* six key predictors that can account for much of the variance in IQ. Given that little research has been

conducted to investigate predictors of IQ, this research is likely to make both theoretical and practical contributions to the field of IQ and training literatures, as discussed in section 7.3.

7.3. Contribution to the Literature

Previous research has highlighted the importance of quality management (Deming 1982; Black & Porter 1996) and information quality management (Redmen 1992; Wang 1998). There is also literature on identifying and empirical testing critical success factors for quality management (Flynn et al. 1994; Behara & Gunderson 2001). Many studies in the IQ field have focused on the theoretical modelling of controls (Redman 1998) and measurement/ dimensions of information quality (Ballou et al. 1985, 1987; Wang & Strong 1996; Huang et al. 1999). One of the drawbacks in the existing body of knowledge regarding IQ is lack of identification of key IQ predictors, which to date is largely unexplored. Therefore, this research is the first empirical study that investigates IQ predictors for ensuring better IQ, and is an extension of IQ theory not previously addressed.

Researchers of both training and IQ can benefit from this study in a number of ways: Firstly the conceptual model presented in this study is useful to researchers interested in examining the intersection of these two disciplines. It is also particularly applicable to researchers examining various aspects of IQ predictors and those researchers examining various characteristics of the relationship between training, work environment, trainee characteristics and IQ. Subsequently researchers are encouraged to use this model and continue testing its capabilities. One may also benefit from considering the empirical findings of this research in the development of research models examining similar phenomena and provides a useful starting point for subsequent empirical studies. Within the training literature, the conceptual model serves as

an extension of the three-lens framework presented by Baldwin & Ford (1988) that expands each of those three lenses into IQ outcomes. The empirical results of this research contribute to the training literature by demonstrating that IQ has a quantifiable relationship to each of these training constructs.

In Summary, the research has theoretical implications in the following key areas; an extension of theory to an area not previously addressed; the development of an IQ predictor conceptual model and the identification of key predictors of IQ that are critical for ensuring high IQ. The empirical results of this research also contribute to the IQ literature by demonstrating that the three constructs identified in the training literature have a systematically quantifiable relationship to IQ. The empirical results of this research should also be of benefit to practitioners as discussed in section 7.4.

7.4. Implications for Practitioners

The previous section discussed the implications for theory. Practitioners can also benefit from this study. There can be no doubt that the critical impact factors (predictors) identified by the study can serve practitioners in training management as a useful guide to IQ management training activities, and IQ improvement efforts. This study is a reminder of the importance of information quality management and helpful to organisations in obtaining a better understanding of IQ. In addition to this, the finding of this research have the potential to help training managers and organisations focus on the most important predictors of IQ, thereby obtaining greater benefit from less effort. If organisations focus on these factors, they may be able to evaluate and improve the perception of IQ in their organisations and thereby ensure better IQ outcomes. The six factors identified as significant predictors of IQ also has significance for health officials as it provides a reference for training managers and focusing their attention and resource allocation for training plans.

Additionally they will be able to identify areas of IQ where improvements should be made, and therein improve overall IQ. However, training managers should note that the fact that some IQ dimensions which were not included in this study should not be interpreted as them having no meaningful, practical training applied to them. Finally practitioners can benefit by using the IQTRAG developed in this study for designing effective IQTPs (Chapter 6).

7.5. Limitation of this Study

In the laboratory experiment the impact of training on IQ was investigated. When designing the experiment, one limitation was information complexity. The documentation recording process was relatively simplified. The limitations of the experiment were mainly focused on the existence of the identified relationship, due to the oversimplified experimental scenario. Thus information was limited to a low complexity level, which would not be a true reflection of the information complexity in a real world hospital setting. Ultimately experimental design is intrusive and difficult to carry out in most real world contexts. Because an experiment is often to some extent an intrusion, an artificial situation was set up to assess a causal relationship with high internal validity, which limits the degree to which the results can be generalized in contexts where an experiment was not set up.

As discussed in Chapter 4, since the experiment was conducted in the domain of student nurses there may be bias in the sample towards inexperienced nurses. However, although the interpretation of the experimental findings is limited in context and the empirical results cannot be generalized beyond the population represented by the sample, this analysis has demonstrated the ability to predict the impact of training on IQ outcomes. There is room for many more experiments and with much larger number of subjects. However, the results have been confirmed by survey data and qualitative

interviews. This increased the external validity to support the findings, and since healthcare is a typically information rich organisation the results may be applied to other business domains. Another limitation of this study is the correlation between IQ dimensions.

From the methodology perspective limitations of the survey were noted. A subjective assessment a survey research methodology was used to validate IQ. Some limitations of survey research are whether the respondents accurately reflect their viewpoints and whether their perspectives accurately reflect the real world. Based on previous literature, this study moderated this limitation by adopting a validated survey and providing reliability and validity analysis. Due to time and resource constraints there were some limitations in the approach to data gathering. Because of the prevalence of spam, 'Web-based surveys' tend to have low response rates (Bullen 2005). This created a small sample size, thus reducing the statistical power of the data and increasing the probability of both Type I and Type II errors i.e. detecting relationships where none exist and failing to detect relationships where they do exist (Mertler & Vannatta 2005).

Arguably the main restraining factor of this study was the restricted survey area. This was constrained to Ireland; therefore, the conclusions drawn from this study may have a potential problem on generalisability. However, evidence (Chapter 1) suggests that differences in IQ issues in Ireland, USA, and other western countries are likely to be minor. Although the results of this study are only drawn from hospitals in Ireland, there may be similar results if a study was conducted in other western countries. Whether this is the case or not, similarities and differences need to be further investigated.

In addition, the scale of the questionnaire was reduced from 1-10 to 1-5 (Wang & Strong 1996) and this may have had an effect on the results. Even so the

result of this research can provide a first step towards a comprehensive IQ model. The model and the results obtained from this study offer a valuable basis for further research. Several limitations of this study were described. Admittedly, the evidence from this research is limited and may be indicative of other effects not measured at an observable level within the scope of this effort. As such, further research is encouraged to better understand the relationship between other predictors and IQ.

7.6. Recommendations for Further Research

This study has revealed the presence of an empirically measurable, systematic relationship between training, work environment, trainee characteristics and IQ. Based on these findings it is recommended that organizations should undertake an Information Quality Training Requirements Analysis by utilising these predictors before setting up an Information Quality Training Plan.

Future research is motivated in acknowledgement of the need to create an Information Quality Training Requirements Analysis Method that specialises in method engineering. As stated by Hevner et al. (2004) experts in the respective field should be consulted to develop the method content thus assuring method quality, quality of created artefacts, relevance and scientific rigour by the interaction of practitioners and researchers. Research similar to this work, but using a different regression model, is recommended. Such a study could build directly on the findings of this research. Researchers are also encouraged to conduct similar research using different measurements of IQ outcomes other than accuracy, consistency and completeness. Such studies may reveal additional relationships not evident in this study.

Finally, researchers are encouraged to seek validation of these findings through research conducted in accordance with research paradigms other than the Design Science approach used in this study (such as a positivist approach). Such studies can provide valuable validation of these findings.

This research has explored the effects of training design, trainee characteristics and the work environment on IQ outcomes (accuracy, completeness and consistency). In future research, other dimensions of IQ should be investigated. For example, it would be beneficial to develop a comprehensive and validated model to measure the impact of the constructs of this study on all IQ dimensions.

7.7. Conclusion

The training literature identified predictors of transfer of training on performance; however, little attempt was made to study and empirically test these predictor capabilities on IQ. This research identified the important predictors of transfer of training as also being important predictors of IQ; provided a data measurement instrument; developed an IQ predictor model; demonstrated that the relationship between the predictors and IQ is systematically measurable and has created awareness of the importance of training design, the work environment and trainee characteristics on IQ. The IQ predictor model developed using a rigorous ontology approach made it possible to develop an Information Quality Training Requirements Analysis Guideline. This guideline can help to create more efficient and effective IQ training programs tailored to the IQ needs of the information user.

This research has identified the relationships between the three constructs of the conceptual model and IQ by undertaking a systematic examination from both a quantitative and qualitative perspective. The analysis has demonstrated

the ability to identify many predictors of IQ, based on the measurement of the selected IQ dimensions (accuracy, completeness and consistency). As such, these findings can provide a starting point for subsequent empirical examination.

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Appendix A: Medical Error Studies

Study	Participants	Discharge Documents	Admittance Documents	Medication Charts	Incomplete Prescription	Inconsistent Prescriptions	Medication inaccuracy	Discrepancies Medical Errors	Affected Patients	Drug omission / Commission
RCSI April, 2008	139	o						10.8%	65.5%	20.9%
Toronto General Hospital, 2006	150				o			70.7%	29.5%	22.9%.
Dept of Pharmacy, Sunnybrook, Toronto, ,	151		o					53.6%	38.6%	46.4%
Faculty of Medicine, University of Ottawa,	22 studies (3755)		o				67%	19%- 75%	11%-59%	60%- 67%
Clinic of Internal Medicine Bispebjerg Hospital, Copenhagen,	200	o	o					7%		19%
Markham Stouffville Hospital, Canada	60	o	o					60%	18%	
Clinical Pharmacology, Auckland Hospital, New Zealand.	100	o	o	o			8.58%	1.70%		
Tåbelund Primary Health Care Centre, Eslöv, Sweden	69	o	o				18.7%			
Dept of Community Medicine, University of Ribat ,Khartoum,.	1000				o	80.5%	59.7%			
Klinik für Anästhesiologie-AG Allgemeinmedizinische ersorgung, Universitätsklinikum Schleswig-Holstein, Campus, Lübeck	536	o						58%		
University of California, Dept of Medicine, Los Angeles.	122	o						83%		
Division of General Medicine, Brigham & Women's Hospital, Boston, USA.	180	o	o					72%	12%	
Hospital Pharmacy, Roskilde Hospital, Denmark	75	o	o					2-7%	13%	
Dept of Pharmacy, Medical Center, Phoenix, Arizona	851		o					3.3%		
Nottingham University Hospitals, UK	108	o				66.6%			38%	
State University Family Physicians of Kingsport, USA	157							97%	32%	

Appendix B: Experiment Instruction Sheet

TIDQ HOSPITAL DOCUMENTATION INSTRUCTIONS

This is to help you understand what is expected of you.

Discharge Patients:

- Fill in any or all **follow up appointments** assuming there is a already an available appointment.
- Fill in all relevant **discharge** details excluded from patient charts
- Fill in **transfer forms** for the appropriate dates assuring that the transport has been looked after.

Admit Patient:

- Fill in **vital signs** for relevant patients Blood Pressure, Temperature **°C**, Heart Rate and Respiration etc…
- Fill in all personal details available to you on past medical history allergies medications etc where this information is missing from admittance chart
- Set up drug regime for new patient and administer drugs at the appropriate time after admission.

Administering Medications;

- Fill in all **medications** administered recording the appropriate times in the correct medical format

Other Considerations:

- Ensure all appropriate forms are signed and dated correctly
- NB: Date is always entered in dd/mm/yyyy format except where (dd/mm is explicitly stated)
- Times are entered using the 24hr clock
- Use the correct medical terminology as outlined for entering drug dosages

A range of conversions chart are provided for your assistance.

Appendix C: NEO_PI Personality Test

NEO PI-R	PERSONALITY TEST FOR EXPERIMENT				
ASSERTIVENESS (Alpha = .84)	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate / Accurate	Moderately Accurate	Very Accurate
+					
Take charge.	☐	☐	☐	☐	☐
Try to lead others	☐	☐	☐	☐	☐
Can talk others into doing things.	☐	☐	☐	☐	☐
Seek to influence others.	☐	☐	☐	☐	☐
Take control of things.	☐	☐	☐	☐	☐
-					
Wait for others to lead the way.	☐	☐	☐	☐	☐
Keep in the background.	☐	☐	☐	☐	☐
Hold back my opinions.	☐	☐	☐	☐	☐
Have little to say	☐	☐	☐	☐	☐
Don't like to draw attention to myself	☐	☐	☐	☐	☐
Hold back on my opinions	☐	☐	☐	☐	☐
INTELLECT (Alpha = .86)	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate / Accurate	Moderately Accurate	Very Accurate
+					
Like to solve complex problems.	☐	☐	☐	☐	☐
Love to read challenging material	☐	☐	☐	☐	☐
	Very Inaccurate	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
Have a rich vocabulary	☐	☐	☐	☐	☐
Can handle a lot of information.	☐	☐	☐	☐	☐
Enjoy thinking about things.	☐	☐	☐	☐	☐
-					
Am not interested in abstract ideas.	☐	☐	☐	☐	☐
Avoid philosophical discussions.	☐	☐	☐	☐	☐
Have difficulty understanding abstract ideas	☐	☐	☐	☐	☐
Am not interested in theoretical discussions	☐	☐	☐	☐	☐
Avoid difficult reading material.	☐	☐	☐	☐	☐
SELF-EFFICACY (Alpha = .78)	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate or Accurate	Moderately Accurate	Very Accurate
+					
Complete tasks successfully.	☐	☐	☐	☐	☐
Excel in what I do.	☐	☐	☐	☐	☐
Handle tasks smoothly.	☐	☐	☐	☐	☐
Am sure of my ground.	☐	☐	☐	☐	☐
Come up with good solutions.	☐	☐	☐	☐	☐
	Very Inaccurate	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
Know how to get things done.	☐	☐	☐	☐	☐
-					
Misjudge situations.	☐	☐	☐	☐	☐
Don't understand things.	☐	☐	☐	☐	☐
Have little to contribute.	☐	☐	☐	☐	☐
Don't see the consequences of things.	☐	☐	☐	☐	☐

ORDERLINESS (Alpha = .82)	**Very Inaccurate**	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
+					
Like order.	☐	☐	☐	☐	☐
Like to tidy up.	☐	☐	☐	☐	☐
Want everything to be "just right."	☐	☐	☐	☐	☐
Love order and regularity.	☐	☐	☐	☐	☐
Do things according to a plan.	☐	☐	☐	☐	☐
-					
Often forget to put things back in their proper place.	☐	☐	☐	☐	☐
Leave a mess in my room	☐	☐	☐	☐	☐
Leave my belongings around	☐	☐	☐	☐	☐
Am not bothered by messy people.	☐	☐	☐	☐	☐
	Very Inaccurate	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
Am not bothered by disorder.	☐	☐	☐	☐	☐
DUTIFULNESS (Alpha = .71)	**Very Inaccurate**	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
+					
Try to follow the rules.	☐	☐	☐	☐	☐
Keep my promises.	☐	☐	☐	☐	☐
Pay my bills on time.	☐	☐	☐	☐	☐
Tell the truth.	☐	☐	☐	☐	☐
Listen to my conscience.	☐	☐	☐	☐	☐
-					
Break rules.	☐	☐	☐	☐	☐
Break my promises.	☐	☐	☐	☐	☐
Get others to do my duties.	☐	☐	☐	☐	☐
Misrepresent the facts.	☐	☐	☐	☐	☐
Do the opposite to what is asked	☐	☐	☐	☐	☐
ACHIEVEMENT-STRIVING (Alpha = .78)	**Very Inaccurate**	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
+					
Go straight for the goal	☐	☐	☐	☐	☐
	Very Inaccurate	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
Work hard.	☐	☐	☐	☐	☐
Turn plans into actions.	☐	☐	☐	☐	☐
Plunge into tasks with all my heart	☐	☐	☐	☐	☐
Do more than what's expected of me	☐	☐	☐	☐	☐
Set high standards for myself and others.	☐	☐	☐	☐	☐
Demand quality.	☐	☐	☐	☐	☐
-					
Am not highly motivated to succeed.	☐	☐	☐	☐	☐
Do just enough work to get by.	☐	☐	☐	☐	☐
Put little time and effort into my work.	☐	☐	☐	☐	☐

SELF-DISCIPLINE (Alpha = ..85)	**Very Inaccurate**	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
+					
Get chores done right away.	☐	☐	☐	☐	☐
Am always prepared.	☐	☐	☐	☐	☐
Start tasks right away.	☐	☐	☐	☐	☐
Get to work at once.	☐	☐	☐	☐	☐
Carry out my plans.	☐	☐	☐	☐	☐
-					
Find it difficult to get down to work.	☐	☐	☐	☐	☐
	Very Inaccurate	**Moderately Inaccurate**	**Neither Inaccurate or Accurate**	**Moderately Accurate**	**Very Accurate**
Waste my time.	☐	☐	☐	☐	☐
Need a push to get started.	☐	☐	☐	☐	☐
Have difficulty starting tasks.	☐	☐	☐	☐	☐
Postpone decisions.	☐	☐	☐	☐	☐
CAUTIOUSNESS (Alpha = .76)	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate or Accurate	Moderately Accurate	Very Accurate
+					
Choose my words with care.	☐	☐	☐	☐	☐
Stick to my chosen path.	☐	☐	☐	☐	☐
Avoid Mistakes	☐	☐	☐	☐	☐
-					
Jump into things without thinking.	☐	☐	☐	☐	☐
Make rash decisions.	☐	☐	☐	☐	☐
Like to act on a whim	☐	☐	☐	☐	☐
Rush into things.	☐	☐	☐	☐	☐
Do crazy things	☐	☐	☐	☐	☐
Act without thinking	☐	☐	☐	☐	☐
Often make last minute plans	☐	☐	☐	☐	☐

Appendix D: Patient Record

TIDQ HOSPITAL PATIENT RECORD		
WARD:	**MRN**:	**CONSULTANT:**
Surname: **First Name**: **Known as:** **Maiden Name:**		
Address:	**Nationality**	GP:
Telephone:	**Date of Birth:**	**Age:**
Occupation:	**Gender**	**Marital Status:**
Religion:	Sacrament of the sick	Date:
Next of Kin Address **Telephone:** Relationship:	**Next of Kin 2** Address: **Telephone:** Relationship:	
Admission Date: **Time** Accompanied by:		
Reasons for Admission:		
Diagnosis when confirmed:		
Past Medical History:		
Past Surgical History:		
Physical Examination:		
Known or suspected transmissible organisms: Yes ☐ No: ☐ Details Requires isolation: : Yes ☐ No: ☐		
Medication on Admission:		
Medications Sent home: Yes ☐ No: ☐ Prosthesis:		
Known ALLERGIES:		**WEIGHT**
URINALYSIS:		
Temperature_____ **Pulse** _____ **Blood Pressure** _____ **Respiration** _____		
Patient informed on admission that they may be transferred to discharge lounge on day of discharge ☐		
Policy of hospital explained to patient or his /her relatives ☐		
Valuables held : Yes ☐ No: ☐		
Staff Nurse Signature:		**Date**:
NURSING CARE NOTES		

PATIENT'S NAME		MRN:
TIDQ HOSPITAL LABS ORDERED		
Date:	**Investigations:**	**Results:**
Prior to Discharge		
For Discharge to: Date:		
Next of Kin informed of discharge: Yes ☐ No: ☐ Name:		
Liaison Nurse informed? Yes ☐ No ☐ N/A ☐ Home Help informed: Yes ☐ No ☐ N/A ☐		
Convalescence required? Yes ☐ No ☐ N/A ☐ Booked? Yes ☐ No ☐ N/A ☐		
Public Health Nurse informed? Yes ☐ No ☐ N/A ☐ Meals on Wheels? Yes ☐ No ☐ N/A ☐		
Day Hospital informed? Yes ☐ No ☐ N/A ☐ Home Visit Yes ☐ No ☐ N/A ☑ Date _____		
Comments:		
Transport required? Yes ☐ No ☑ Booked Yes ☐ No ☐ N/A ☑ Date _____		
Equipment required on discharge? _____Ordered Yes ☐ No ☐ N/A ☑ Date _____		
Type – please Specify:		

PATIENT NAME:	MRN
Day of Discharge	
Diet sheet: ☐ Doctors Letter: ☐ Prescription: ☐ Outpatient appointment: ☐	
I.V. Cannula removed: ☐ Transfer Letter: ☐ Transferred to Discharge Lounge: ☐	
Comments / instructions given:	
Valuables returned: Discharged to Date Time:	
Signature:	

TIDQ HOSPITAL PRE-OPERATIVE CHECKLIST
IQ EXPERIMENT 2008

			Patient Name: MRN:		
	YES	NO		YES	NO
Completed consent form			Nil by mouth since 12 midnight		
X-Rays			Name badge in place		
ECG			Drug Kardex		

Seen by Anaesthetist	YES	NO	N/A

ALLERGIES:

Temperature_____ Pulse _____ Blood Pressure _____ Respiration _____

Weight _____ Height _____ Urinalysis _____ O2 Saturation _____

Additional Information:

Nurses Signature: _____ Date: _____

PATIENT OBSERVATION CHART

IQ EXERIMENT 2008	SURNAME
Show daily (morning) or more frequent if required	FIRST NAMES
Date:	MRN No:

Frequency																	
Date																	
Time																	
Blood pressure		C															
	250																
	240																
	230																
	220																
	210																
	200																
	190																
	180																
	170																
	160																
	150																
	140																
	130																
	120																
	110																
	100																
	90																
Pulse	80																
	70																
	60																
	50																
	40																
Respiration	30																
	20																
	10																
	0																
BP																	
RR																	
T																	
HR/P																	

Signature

TIDQ HOSPITAL DRUG PRESCRIPTION AND ADMINISTRATION RECORD *(MUST USE A LEADING 0 BEFORE A DECIMAL POINT)*														
REGULAR MEDICATION CHART		**TIME**	**ADMINISTERED BY INTIIALS**											
Start Date		Date/ Month →												
Drug		Time ↓												
Dose														
Frequency														
Route														

REGULAR MEDICATION CHART		**TIME**	**ADMINISTERED BY INTIIALS**											
Start Date		Date/ Month →												
Drug		Time ↓												
Dose														
Frequency														
Route														

REGULAR MEDICATION CHART		**TIME**	**ADMINISTERED BY INTIIALS**											
Start Date		Date/ Month →												
Drug		Time ↓												
Dose														
Frequency														
Route														

SURGICAL ANTIBIOTICS PROPHYLAXIS (VALID FOR 24 HOURS)												
Date	Drug	Dose	Route	Frequency	Initials	08:00	10:00	12:00	14:00	16:00	18:00	20:00

DRUGS NOT ADMINISTERED					
DATE	TIME	DRUG	INITIAL	REASON	SIGNATURE

TIDQ HOSPITAL PATIENT APPOINTMENTS			
DATE	**TIME**	**CLINIC/ CONSULTANT**	**HOSPITAL**

Appendix E: Scenario Example

Under Dr Harry on 01/09/2008

RECORD VITAL SIGNS

DRUG ADMINISTRATION FORM

Harriette is a 80 year old female with PMH of OA and was admitted to the hospital through the A&E on 1st September 2008 at 9.15 am complaining of jaundice for 2 months. Harriette's jaundice was noticed by her GP and advised to attend the A&E for investigation. Harriette was admitted to a different hospital 2 monts ago.

Liver U/S showed gallstones and she had a laproscopic cholecystectomy 2 months ago.

After surgery Jaundice decreased slightly but then returned. Harriette has no other complaints but persistant itching for 2-3 days. She has no abdominel pain, no N/V/D/C. Harreitte states that she has lost 30lbs in the past year despite her good appetite.

Reason For Admission:

PMH of OA Jaundice for 2 months and persistant itching for 2-3 days

Past Medical History:

OA, EGD/Colonoscopy 4 months ago reported as normal.

Past Surgical History:

Cholecystectomy 2 months ago. Appendectomy and explorative laparotomy for intestinal obstruction years ago.

Vital Signs on Admittance:

T: 36.5	HR: 86
RR: 16	BP: 155/66

Medications:

Celebrex 200mg (100mg BID) PO

Arthrotec 225mg 3 timed daily PO

ASA 81 mg QD PO

FMH 2.5mg daily PO

HTN 100mg/d QD PO

Physical Examination:

WD/WN in NAD, visible skin and scleral icterus

No stigmata or chronic liver disease

Abdomen: soft, NT, ND, + BS, 4 'keyhole scars form the laparoscopic cholecystectomy, old laparotomy scar.

Weight: 58kg

Labs:

CBCD

CMP

UA

Liver U/S or CT of the Abdomen and pelvis

Alergies None

Biographical data

Name Harriette Cash	**Gender** Female
M.R.N. B012	**Address** 25 Alderwood Avenue, Swords, Co Dublin
Phone(H 01- 2599515	**Marital Status** Married
Occupation Carpenter	**Nationality** Irish
Religion RC	**GP** Dr Moodley
Consultant Dr Harry	

Appendix F: Plain Language Statement

DUBLIN CITY UNIVERSITY BUSINESS SCHOOL/NURSING /COMPUTING

Project:_____

Introduction

_____

_____

_____

What you will be asked to do?

_____

_____

_____

Are there any potential risks?

_____

_____

_____

How will your confidentiality be protected?

_____

_____

Are there any Benefits (direct or indirect) from involvement in the Research Study?

_____

_____

How will you receive feedback?

_____

_____

_____

Will participation prejudice you in any way?

_____

_____

Where can you get further information?

_____

_____

_____

How do you agree to participate?

_____

_____

If participants have concerns about this study and wish to contact an independent person please
Contact:

Tel _____

Appendix G: Informed Consent Form

DUBLIN CITY UNIVERSITY

Informed Consent Form for Persons Participating in Research Project

PROJECT TITLE*:*

Name of participant:

Name of investigator(s): (Lecturer/Researcher),

1. I have read the plain language statement and I consent to participate in the project named above, the particulars of which have been explained to me. A written copy of the information has been given to me to keep.

2. I authorize the researcher to use for this purpose the results of my practical test and documentation referred to under (1) above.

3. I acknowledge that this research is for the purpose of Mary Levis's PhD thesis and contribution to knowledge.
(a) My involvement requirement has been explained to me to my satisfaction:
(b) I have been informed that I am free to withdraw from the project at any time without explanation or prejudice and to withdraw any unprocessed data previously supplied;
(c) The project is for the purpose of research

I have been informed that the confidentiality of the information I provide will be safeguarded subject to any legal requirements.

I have been informed that participation or non participation in this study does in no way effect my grades for the information management module

I have read and understood the information in this form. My questions and concerns have been answered by the researchers, and I have a copy of this consent form. Therefore, I consent to take part in this research project

Signature: Participants Signature:
Name in Block Capitals:----------
Witness: ----------
Date:---------- Student ID----------

Appendix H: Survey Questionnaire

TRAINEE CHARACTERISTICS		**(CONSCIENTIOUSNESS)**				
	Self Discipline **(SCORE)**	Strongly Disagree	Disagree	Neither Agree/Disagree	Agree	Strongly Agree
	I usually get chores done right away					
	I am always prepared for every event					
	I always carry out my plans					
	I usually postpone making decisions for as long as possible					
	Self Efficacy' **(SCORE)**	Strongly Disagree	Disagree	Neither Agree / Disagree	Agree	Strongly Agree
	I always complete tasks successfully					
	I usually excel in everything I do					
	I usually come up with good solutions to problems					
	Sometimes I may misjudge situations.					
	Achievement Striving **(SCORE)**	Strongly Disagree	Disagree	Neither Agree /Disagree	Agree	Strongly Agree
	I usually go straight for the goal					
	I usually turn plans into actions					
	I tend to set high standards for myself and others					
	I am not really highly motivated to succeed					
	Dutifulness **(SCORE)**	Strongly Disagree	Disagree	Neither Agree /Disagree	Agree	Strongly Agree
	I try to follow the rules and seldom break them.					
	I always listen to my conscience					
	I sometimes break my promises					
	I sometimes misrepresented the facts					

TRAINING						
	Duration of documentation training program I attended were usually adequate ***(Interval)***	Strongly Disagree	Disagree	Neither /Disagree	Agree	Strongly Agree
	I have received relevant documentation training ***(Category)***	Strongly Disagree	Disagree	Neither /Disagree	Agree	Strongly Agree
	Time intervals between training were usually adequate	Strongly Disagree	Disagree	Neither /Disagree	Agree	Strongly Agree
	Duration of documentation training program I attended were usually adequate ***(Interval)***	Strongly Disagree	Disagree	Neither /Disagree	Agree	Strongly Agree
	The effectiveness of the training was usually	Poor	Fair	Good	Very good	Excellent
	There is a formal documentation recording training plan in my department **(Binary)**	Yes ☐			No ☐	
	Duration of documentation training I attended were usually	One day or less			More than one day	
	My Experience of documentation is	Very Low	Low	Average	High	Very High
	I consider my documentation recording experience as ***(Category)***	Very Low	Low	Average	High	Very High

WORK ENVIRONMENT						
	Information System					
	Patient admission forms within our organization is mainly **(Category)**	Paper based ☐			Electronic☐	
	Peer Support					
	There is good peer support within the organization?**(Binary)**	YES			NO	
	Form Layout					
	The admission form layout is mainly **(Category)**	Free Style	Tick Box			
	The work environment is	Poor	Fair	Average	Good	Excellent

DOCUMENTATION QUALITY							
		Experiment	Survey				
	Completeness *How often do you find…*	Ratio %	**Never**	**Seldom**	**Sometimes**	**Usually**	**Always**
	Patient MRN number **not** filled in on patient admission forms? **(Category)**						
	Incomplete histories in on patient admission forms**? (Category)**						
	Signatures filled in on patient admission forms? **(Category)**						
	Date of Birth (DOB) **not** filled in on patient admission forms? **(Category)**						
	You have to fill in missing admission data not already recorded in patient admission forms ? **(Category)**						
	Patient's full address in patient admission forms? **(Category)**						
	Patient MRN number **not** filled in on patient admission forms? **(Category)**						
	Consistency *How often do you find…*	Ratio %	**Never**	**Seldom**	**Sometimes**	**Usually**	**Always**
	The date of admission in patient forms always filled in admission form in a consistent format? **(Category)**						
	The patient Date of Birth (DOB) on admission form written in a non consistent format? **(Category)**						
	Weight of patient recorded in the admission form in a consistent format? **(Category)**						
	Accuracy *How often do you find…*	Ratio %	**Never**	**Seldom**	**Sometimes**	**Usually**	**Always**
	Typography errors in patient name on admission forms **(Category)**						
	Wrong MRN number recorded on Patient admission form **(Category)**						
	You need to make corrections to data recorded in patient admission forms **(Category)**						
	Patient Date of Birth (DOB) recorded accurately on admission forms **(Category)**						

DEMOGRAPHICS INFORMATION						
	Gender: (Category)				**☐ Male**	**☐ Female**
	Hospital Country (Nominal)	_____				
	Hospital County (if Ireland) **(Nominal)**	_____				
	Nationality: (Category)	**Irish**	**UK**	**EU *(except Ireland & UK*)**	**Non EU**	
	Profession: (Category)	**Physician**	**Nurse**	**Administration Staff**	**Clerk**	**Other**
	How long are you employed with the organization	**0-1 yr**	**2-3 yrs**	**3-4 yrs**	**5-6 yrs**	**Over 7 yrs**
	How would you rate quality of documented information in your department? (Category)	**Very High**	**High**	**Medium**	**Low**	**Very Low**
	Overall are I am satisfied with the quality of patient admission information in my organisation? **(Category)**	Strongly Agree	Agree	Neither agree /Disagree	Disagree	Strongly Disagree
	What Documentation Training have you received in the last 5 years? *(please tick all that apply*) (Category)	**Conferences**	**Seminars**	**Workshops**	**Other Training**	**None**
	How many training days have you attended in the past calendar year?	**None**	**1-2 days**	**3-4 days**	**5-6 days**	**Over 6 days**
	Of the training days what percentage was specifically dedicated to information recording	**0%**	**1-10%**	**11-20%**	**21-30%**	**Over 30%**
	My primary learning style is	**Visual**	**Auditory**	**Tactile/ kinaesthetic**	**Mixed**	**All of these**
	Consequence of not recording information correctly is:	**Negligible**	**Low**	**Moderate**	**High**	**Very high**
	Difficulty of recording information is	**Very easy**	**Easy**	**Moderate**	**Difficult**	**Very difficult**
	Frequency I record information is:	**Never**	**Seldom**	**Occasionally**	**Often**	**Very often**
	Time spent recording information relative to other duties is:	**0%**	**1-25%**	**26-50%**	**51-75%**	**76-100%**
	I like to train at	**A steady pace**		**Fits and starts**		
	Organisations would benefit from further IQ training	**YES**		**NO**		
	Trainee characteristics impact on documentation recording	**YES**		**NO**		
	Consistency	Ratio %	Very High	High	Medium	Low Very Low