The Knowledge-Evolving Project: An Exploratory Study of Knowing Acts in a Digitisation Project

المشروع المطور للمعرفة: دراسة استكشافية للتعرف على ممارسات المعرفة في مشروع رقمنة

by

GHASSAN DABBOUR

A thesis submitted in fulfilment

of the requirements for the degree of

DOCTOR OF PHILOSOPHY IN PROJECT MANAGEMENT

at

The British University in Dubai

Professor Ashly H. Pinnington

March 2018

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ABSTRACT

The aim of this research thesis is to explore the knowledge exploitation practices that drive the knowledge evolution spiral of project knowledge management. This is different to the conventional knowledge creation spiral commonly drawn from organisational knowledge management which implies the need for knowledge to grow beyond the organisation. The argument of this thesis is that while a successful organisation applies knowledge to grow beyond its constraints, a successful project is one that applies knowledge to efficiently meet its constraints by developing and assimilating the guiding knowledge that has been predefined and established at the project outset. Since improvisation and spontaneity of knowing acts in projects are an inherent practice, the primary methodology this research deploys is Glaserian Grounded Theory, supported by qualitative analysis of secondary documents for triangulation. The empirical research is conducted on a ‘Maintenance Digitisation Project’ in an organisation that runs real estate and is part of a group of companies. The core categories that emerged were: Inscription, Technological Extension, Discussion, and Redundancy, which are the end products of the study; the knowledge evolving acts. Based on these findings, the study constructs the FRDA (Formalisation, Realisation, Deconstruction, and Assimilation) model–a knowledge management model of the knowledge-evolving project.

ABSTRACT IN ARABIC

الهدف الاساسي من هذه الرسالة البحثية هو تحري ممارسات استغلال المعرفة، التي تدفع 'دوامة تطوير المعرفة' لإدارة المعارف في المشاريع. وهذا يختلف عن 'دوامة خلق المعرفة' التقلدية المنسوبة لإدارة المعارف في المؤسسات. حجة هذه الاطروحة ان في حين المؤسسات الناجحة هي التي تطبق الاستكشاف المعرفي لتنمو خارج حدودها، المشاريع الناجحة هي التي تطبق الاستغلال المعرفي لتلاقي و تفي بحدودها بكفاءة و فاعلية. بما ان الارتجل و العفوية للممارسات المعرفية متأصلة في ادارة المشاريع، تستخدم الدراسة التجربية منهجية التجدير النظري لتشبيع النتائج، تليها منهجية تحليل النوعي للوثائق لتثلث النتائج. لقد تم اجراء البحث التجريبي على مشروع 'رقمنة عمليات الصيانة' في شركة تدير العديد من العقارات. النتائج المشبعة المثلثة التي اكتشفها البحث هي: الكتابة، التمدد التكنولوجي، المناقشة، و التكرار. بناء على هذه النتائج، ستنشئ الدراسة نموذج ال FRDA الذي يعد نموذجا لإدارة المعرفة للمشروع المتطور للمعرفة.

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I am grateful to my family who throughout my study endeavour casually assumed that my PhD award was a matter of fact. Their solid conviction in my abilities was a powerful backbone for support. On several occasions when I was tempted to quit, I would draw energy from their faith in me.

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CHAPTER ONE: INTRODUCTION

1.1 Overview of the Study

The pursuit of a whole, project management exclusive, and bounded discipline of 'project knowledge management' is the exact starting point where this doctoral thesis stands to begin to derive its objectives and aims. This ambitious starting point is not new and has been previously occupied by several scholars of management studies; most notably Gasik (2011), von Wasielewski (2010), Koskinen & Pihlanto (2008), and Kasvi, Vartiainen, & Hailikari (2003). The next steps usually taken by most of such studies, however, involve an indiscriminate absorption of the familiar concepts of knowledge management theory and practice that are well saturated across the various mainstream studies of knowledge management. The problem with this approach is that the kind of knowledge management that the mainstream studies debate are all rooted in Nonaka's (1991) iconic *The Knowledge-Creating Company*, which happens to be a study of *organisational* knowledge management. There are thus seemingly hardly any foundational differences between managing knowledge in projects and managing knowledge in organisations: the philosophical doctrine of tacit knowing, the theoretical view of using knowledge to outgrow the institution, and the practical guidelines of knowledge exploration processes, are embedded in both knowledge management study fields. Investigating a knowledge management discipline idiosyncratic to project management can be potentially rewarding to managing knowledge in projects as well as knowledge management in general. New insights and ideas that channels knowledge management in directions not traveled before are bound to come up.

The first profound idea that reveals itself is of a philosophical nature. The epistemological complications associated with Nonaka's (1991) version of Polanyi's (1958) 'tacit knowing' has been a heated debate in the knowledge management literature for almost thirty years. Tacit knowing has one pillar that cannot be denied of any interpretation: all knowledge is personal (subjective and individualistic) knowledge. The problem then is, how can knowledge exist independently of the conscious knowers? Management scholars have since been peddling with many subject-mediated objects of knowledge using social theories of knowledge. The results were more difficulties and complexities that made knowledge management philosophy almost unreasonable and impractical. To escape this loop the thesis study proposes adopting Sagan's (1977) 'evolution of intelligence': a theory of knowledge that not only demonstrates how knowledge can be independent from knowers, but also shows how mechanical intelligence can be more powerful than a biological one. Sagan's (1977) theory is highly pragmatic not only because it dissolves the complexities associated with subjective knowing, but also addresses the technological advancements of our age.

The second insight comes from the critical analysis of project knowledge management theoretically. The entanglement between project knowledge management and organisational knowledge management goes deeper than Nonaka's (1991) popular *Knowledge-Creating Company*. There is a growing popularity and consensus among management scholars who favour a type of project that encompasses an organisational ontology. Hybrid institutions such as the projectification of organisations, the 'project-based organisation', and the 'temporary organisations' have even lead some project management scholars to redefine the 'project' itself: from project as 'a temporary endeavor' to project as 'a temporary organisation' (Svejvig &

Anderson 2015; Andersen 2008, Pollack 2007). This brilliant idea of blending a project ontology with an organisational one overcomes the numerous difficulties associated with project management theory and practice pushing its boundaries to cover operations that are typically beyond its reach; such as, for example education, information technology, media, politics, and health care (Hodgson 2002). The organisational ontology of project management is often contrasted with the classical one (Geraldi & Söderlund 2016; Cicmil 2006) whose proponents – mostly scholars and practitioners from project management associations such as PMI – focus on studying strategies that efficiently and effectively meet complex objectives rather than exceeding them at an expense (read for example Winter et al. (2006) and Winter et al. (2006)). Thus, project and project management of a classical project ontology is profoundly different from that of an organisational ontology. No doubt for a purely idiosyncratic project knowledge management discipline, project management needs to be defined by a classical ontology of projects and project management rather than an organisational one which has countless features of organisational theory and practice. Remarkably, this distinction has revealed the *Knowledge-Creating Company* to be the opposite of the 'Knowledge-Evolving Project': where innovative knowledge exploration is dominant in organisations, innovative knowledge exploitation is the dominant practice in project management.

This foundational difference reveals a third insight of a practical nature: the justification and rationale for studying those particular knowing acts that are exploitative rather than explorative in the empirical stage of the study. Knowing acts are those actual epistemological activities of comprehension, conception, imagination, sense-making, and interpretation in knowledge management theory and practice. First introduced by Cook & Brown (1999) who observed the epistemological difference between knowledge possessed and knowing exercised, knowing acts are the *de facto* real-life practices that fulfill the *de jure* objectives of knowledge processes. Knowing acts include examples such as languaging techniques (e.g. argumentation, narration, and metaphor), social interaction techniques (e.g. imitation, water cooler talk, and communities of practice), epistemological access techniques (e.g. reading, writing, and watching videos), and praxis techniques (e.g. observation, reflection, and experience). This doctoral study observed how intrinsic and natural knowing acts in project environments are, and decided that interviewing and statistical evaluation (the most typical research methodologies used in doctoral studies) will do no justice to this empirical explorative investigation. The more natural and phenomenological methodologies of grounded theory and document analysis were deployed instead.

The empirical research is conducted on a maintenance digitisation project in an organisation code named 'XAX' that runs a real estate business. XAX itself is a two block building with a small shopping mall in the first three floors. The main objective of the project is the full digitisation of all maintenance operations. An option for later is integrating this new maintenance system with the currently existing leasing and finance system has been left open for consideration later on. The digitisation project is more difficult than it seemed; maintenance operations run on physical paper and the structure and flow of the processes is complicated and deeply ingrained within the maintenance department. The methodology deployed to conduct the empirical research is Glaserian grounded theory, since the knowing acts – knowledge practices exercised to attain knowing – are an inherent part of project management. Qualitative document analysis as a secondary methodology was later deployed to triangulate the saturated results. The end products of the empirical research are the knowledge evolving acts; knowledge practices that are meant to develop and evolve the existing knowledge base rather than explore entirely new ones. These are: Inscription, Technological Extension, Discussion, and Redundancy.

There are obviously a lot of diverse topics to cover to plant the roots (or place the cornerstone) of a full and bounded project knowledge management discipline. Moving from one topic to the next could be challenging for both the reader and the researcher. The way this doctoral thesis is structured is meant to do justice to all of the diverse topics through both covering them and moving coherently between them. The 'knowledge-evolving project' is therefore divided into three subject matters: its philosophy, its theory, and its practice. The reader will observe this division throughout the thesis not just chapter-by-chapter, but also within each chapter. The thesis pivots around establishing a purely project knowledge management enterprise, which will also necessary require it to visit and define the theory and practice of projects, project management, and knowledge management, among organisations and organisational management. Nonetheless, it is important to note that the field of study this doctoral thesis aims to address, and is meant for, is *project management*. Academics and practitioners of project management are the target audience of this doctoral study. More specifically, researchers interested in intrinsic knowledge practices in project management; and project managers who are directly involved with the real world implementation of the project's plans and objectives, are the most likely group to find this study enlightening and beneficial.

1.2 Introduction & Rationale

Knowledge Management in Project Management

Project management has demonstrated itself as an essential element of economic growth, organisation development, and driving business processes, as can be observed across various sectors, industries and institutions in the economy (Svejvig & Andersen 2015). Indeed, the past sixty years have seen organisations increasingly projectise their businesses to accomplish strategic objectives successfully (Morris & Jamieson 2005). Consequently, there has been an increase in the awareness amongst academics and practitioners and interest in managing projects, resulting in rapid expansion of the field of project management (Söderlund 2004). This expansion has roots in the mid-1980s (Saynisch 2010), and is a distinctive indication that project management was evolving outside of its traditional positivist framework by involving other scientific disciplines (such as the social sciences and economic theories) instead of remaining entrenched within the engineering sciences (Gustavsson & Hallin 2014). Subsequently, project practices and operations that assumed universal linear processes and techniques such as project life-cycles, work breakdown structures, and pre-planned tasks became re-modelled into iterative, adaptive, contextual and flexible processes that acknowledge the complexity and dynamics of projects (Cicmil & Hodgson 2006, Winter et al. 2006).

One of the remarkable events that contributed to this expansion of project management was the proliferation of studies in knowledge management. The main programme of knowledge management was to assert that managing knowledge holistically by acknowledging its subjective nature yields better competitive advantage than simply placing it under an information systems umbrella. Knowledge management's original and most popular works were introduced as organisational management practices before circulating on to other management fields. If project management was a story, knowledge management would have been introduced in the chapter where it was first admitted that pre-given knowledge determined at the outset of a project, such as resource allocation, risk assessment, and implementation plans, is always partial and incomplete, especially in the case of complex projects (Engwall 2002). As projects emerge through their lifecycles, the numerous complexities, uncertainties, and concerns appear, and with them the requirements to revise, renovate, and modernise the knowledge outlined at each previous successive stage of the project (Daniel & Daniel 2017; Ahern, Leavy, & Byrne 2014). Thus, knowledge management is a powerful enterprise to engage in for achieving a successful project through all its complexities.

There is however, an important concern that should inconvenience project management scholars interested in a knowledge management discipline exclusive to project management activities and setting; the knowledge management discipline being investigated in the project management literature is heavily based on studies concerned with managing knowledge in organisations (see for example Gasik (2011), von Wasielewski (2010), Koskinen & Pihlanto (2008), and Kasvi, Vartiainen, & Hailikari (2003)). This is mainly because mainstream knowledge management was originally popularised by Nonaka & Takeuchi's (1995) hallmark *The Knowledge-Creating Company*, which was developed in the context of organisations' management. It is nearly positively impossible to submit a study on knowledge management without invoking Nonaka's name. Consequently, there is no foundational differences between project knowledge management and organisational knowledge management. This might not be a problem in itself, but a knowledge management discipline idiosyncratic to project management needs to be given a chance to introduce new ideas and concepts that are potentially significant to managing knowledge in projects and knowledge management, in general.

The knot between project knowledge management and organisational knowledge management has three levels; the philosophical, the theoretical, and the practical. Philosophically, the epistemological difficulties of organisational knowledge management associated with transforming knowledge types from one form to the next has been debated in plenty of the literature for over thirty years with no real solution. It is not wise to instinctively adopt them into a project knowledge management discipline just because they make up most of the mainstream knowledge management material. An alternative philosophy of knowledge should be adopted to project knowledge management. Theoretically, the organisation management maxim that requires the organisation to use knowledge to grow beyond its constraints doesn't make sense to project management. Projects need to meet constraints rather than deliberately outgrow them. Practically, the knowing acts and knowledge processes of the knowledge creating-company that encourage the exploration of radically new knowledge does not work on a project setting that is intended to develop and evolve the predefined existing knowledge base as the project emerges. In a project setting, knowing acts related to knowledge exploitation should be highlighted and acknowledged as the base make-up of the knowledge processes of project knowledge management. The following sections will break up each of the three levels and provide a brief introduction on each.

Mainstream Knowledge Management Philosophy

The prevailing mainstream (organisational) knowledge management arguments and debates that are absorbed by most of the highly cited project knowledge management studies (such as Leybourne & Kennedy (2015), Wiewiora et al. (2014), Meloni & Villa (2007), Koskinen (2004), and Fernie et al. (2003)) face the dilemma of centralising knowledge exclusively with the conscious knower and yet paradoxically granting it the ability to exist independently. This puzzle has captivated the attention of many classical scholars of knowledge management (KM), each arguing for slightly different approaches. One interesting approach links different epistemological objectives with specific epistemological access, for example, Choo's (1998) KM model of sense-making, decision making, and knowledge creating; Wiig's (1993) KM model of factual, conceptual, expectational, and methodological knowledge; and Boisot's (1998) I-Space KM model. But perhaps the most abundant successful theory that addresses this phenomenon is the cross-interaction between subject knowledge and object knowledge, such as the tacit and the explicit, the personalised and the codified, the knowledge and the information, and the personal experience and the social setting. The cross interactions – the transformation of knowledge forms – require the exercising of different knowledge processes, such as knowledge capture, assimilation, codification, transfer, and application.

The categorisation of knowledge into knowledge forms and their transformation mechanisms seems to have since gathered momentum swiftly and zealously. The many inconsistencies with this particular way of thinking have eventually surfaced, which led to fascination with another approach; one that supposes knowledge to be a processual flow rather than entative forms (Styhre 2003; Styhre 2003). This approach requires that knowledge exist in an infinite process of becoming, no matter if it resides in the human memory or on the computer hard drive, in effect retaining the subjectivity of the conscious knower. The problem with this approach, however, is that it is highly ambiguous with no immediate practical implications and thus confusing for the field of management theory. Why would a project management practitioner care about a 'sentient' knowledge? Isn't it better to talk about creativity and imagination instead? Its confusion even stretches further as a conceptual difficulty. For instance, 'Processual' knowledge and 'knowing acts' are very different notions that are often misunderstood for being one and the same (see for example Cook & Wagenaar 2012). The confusion can actually be seen in Nonaka's later publications, such as Nonaka & Toyama (2003), who experimented with what they called dialectic thinking. With it, Nonaka was able to revise his knowledge creating theory and incorporate the processual view of knowledge rather than the earlier entative one. His conclusion is that knowledge exists simultaneously in cognition as well as in action, with ‘Ba’ being the different epistemological places upon which respective epistemological actions are taken. It is by using dialectic thinking with ‘Ba’ appropriately that meaningful knowledge can be created, shared, assimilated, and stored. Signature phrases such as ‘here and now’, ‘context-specific’, and ‘phenomenological’, which directs the analysis of processual knowledge are cited throughout this paper. But at the same time, they are confused with knowing acts such as in the concepts of ‘dialogue’, ‘social interaction’, and ‘learning-by-doing’. It might be that this confusion is primarily because there is no line drawn distinguishing between knowledge theories and social theories of knowledge (see for example Chiva & Alegre 2005). Possibly, this is the reason why ‘processual’ knowledge and ‘knowing acts’ are often combined in confusing ways.

An Alternate Philosophy of Knowledge

This high amount of complexity is perhaps a signal that the entative vs. processual knowledge debate has probably reached a dead-end; and more pertinently now, since knowing as a faculty of a human knower is being surpassed by knowing as a faculty of an artificial knower. In this post-information age, as artificial intelligence technology and research progresses and matures, especially in the field of machine learning, the line that separates human thinking from machine processing becomes progressively more blurred. Brown, Duguid, & Weinberger (2017) describe the ‘autonomous agent’; a technological artifact that carries out information manipulation with an increasing degree of autonomy and independence from its user. Similarly, Cook (2010) offers a different approach to assessing the capabilities of the technological artefacts in comparison with that of biological humans because, he argues, the classical Turing vs Searle debate is no longer relevant given the recent breakthroughs in artificial intelligence: strong artificial intelligence doesn't require consciousness (Harari's 2017). The kind of information processing that we are familiar with (either algorithmic or heuristic) is being replaced by far more exhilarating 'cognitive' capabilities, such as deep learning (Goodfellow, Bengio, & Courville 2016), knowledge representation and reasoning (Russell & Norvig 2010), and computational creativity (Pereira 2007); all of which are offering preliminary experimental evidence that machines can create meaningful knowledge. That stage has not yet been reached, but its achievement is well on its way.

This is what Sagan (1977) speculated on in his marvelous The Dragons of Eden: Speculations on the Evolution of Human Intelligence. Using scientific theories and philosophical explorations of the very controversial theory of human evolution, Sagan (1977) studied how intelligence capability of a single cellular organism started in the DNA and later expanded to the mind–extra-genetically–and then further expanded outside the biological body–extra-somatically. The implication of this theory is that extra-somatic intelligence is not limited to knowledge storage and circulation, but is also showing early signs of capability for creating meaningful knowledge autonomously. Furthermore, moving extra-somatic to extra-genetic and back is not like moving from tacit to explicit and back. The process of shifting between an extra-genetic and extra-somatic mode of intelligence is one of *enhancement* rather than *transformation*. One form of intelligence is applied to enhance the knowledge and knowing dexterity of the other form; whether it's between extra-genetic to extra-genetic, extra-genetic to extra-somatic, extra-somatic to extra-somatic, or extra-somatic to extra-genetic.

This simple yet astonishing speculation renders the entative vs. processual knowledge debate irrelevant because it decentralises knowing as an exclusive faculty of biological beings by two significant means; firstly, extra-somatic knowing can be independent of human participation, and secondly, extra-somatic knowing has a superior information handling capability in terms of speed, storage capacity, and crossing of space and time boundaries. The externalisation of knowledge no longer becomes a philosophical dispute to ponder on. In fact, what is most striking about Sagan's (1977) speculations is that they are more scientific than they are philosophical. In an interesting piece of news, almost 40 years after Sagan (1977), the Independent reported that the social media giant 'Facebook' shut down an artificial intelligence program that created its own language that wasn't readable by humans, which it used to communicate between its robots. Between two robots communicating in their own language, in Nonaka's (1991) terms, it could potentially be classified as a tacit-tacit conversation. Likewise, it is also plausible to consider that natural language generation in A.I. systems involve knowledge conversion from the tacit to explicit (Stent & Bangalore 2014). Differences between knowledge generated neurologically in the brain and knowledge generated in artificial neural networks are becoming progressively more indistinguishable (Cartwright 2015). This is not merely philosophy, this is objective science. How would a project knowledge management discipline involving autonomous A.I. look like? It is astonishing how present day (nonhuman) computing machines manipulate existing data to create new knowledge, but is it not too early to assume that these nonhuman machines are capable of creating knowledge without the support of predetermined guiding knowledge bases? Artificial intelligence is thriving more so than ever before, and many scholars and technologists believe that the technological singularity – the event when computing machines render human minds almost irrelevant – is inevitable (Callaghan et al. 2017).

The ability of nonhuman intelligence to create meaningful knowledge independent of their human handlers should be part of the mainstream discussions in the knowledge management literature. Project management, particularly project knowledge management, needs to address the stunning progress in artificial intelligence that is being witnessed at this age. Sagan's (1977) theory is realistic, practical, and addresses these scientific progresses of today. It is a simple (complexity free) and stable (contradiction free) foundational philosophy of knowledge that prepares project knowledge management as an independent discipline for all the theoretical and practical challenges that will introduced next.

Knowledge Management Theory: Projects vs. Organisations

The philosophical foundations of Nonaka's (1991) *Knowledge-Creating Company* are not the only fundamentals that made their way into project knowledge management publications. Theoretically, what makes project knowledge management unique to project management is not a topic readily found in literature. Those few studies and debates that address this issue are somewhat vague as to where exactly project knowledge management and organisational knowledge management become separated. This is perhaps most evident in Gasik's (2011) study that attempts to create a complete project knowledge management model exclusive to project management by aggregating all of the familiar concepts of organisational knowledge management into a project micro-knowledge (task level) configuration, and a project macro-knowledge (organisation level) configuration that secures the knot between organisational knowledge management and project knowledge management rather than dissolves it. Similarly, in a guest editorial of a special issue of the *International Journal of Managing Projects in Business* that addresses knowledge creation in projects and project-based organisations, Canonico et al. (2013) acknowledges that Nonaka &

colleagues' study of knowledge management is based on organisational context, yet later notes that many of the empirical examples given by Nonaka and colleagues actually come from a project context. Even more surprising is Pemsel & Wiewiora's (2013) study that had no intention of making this distinction although it discriminates between project knowledge management and organisational knowledge management by interpreting the project management office as knowledge brokers in a project-based organisation. The trend is observable too in research work addressing project-based learning and organisational learning. In an interesting exploratory study by Scarbrough et al. (2004), project-based learning processes are a subservient sub-level to organisational learning as the two blend into knowledge absorption. It seems that studies that attempt to draw a distinct line between organisational knowledge management and project knowledge management can do so only quietly or inconclusively.

Understanding the theoretical differences between a project knowledge management discipline and an organisational knowledge management one involves understanding differentiated levels of analysis to identify how knowledge management is distinctive from either level; but even outside the arguments of the *Knowledge-Creating Company* and knowledge management disciplinary perspectives, it turns out that the project management literature itself can make this distinction near impossible to maintain. Studies such as Cicmil, Lindgren & Packendorff (2016), Hodgson & Cicmil (2016), and Packendorff & Lindgren (2014) are some of the vibrant investigations that move Andersen & Svejvig's (2013), Pollack's (2007), Winter et al.'s (2006), and Winter et al.'s (2006) rethinking of project management on to the next step. Central to these theoretical reinterpretations is the pivotal review of projects as temporary organisations as opposed to temporary endeavours (Andersen 2008), the increasing popularity of project-based organisation, and the projectification of organisations (Miterev, Mancini & Turner 2017, Prado & Sapsed 2016; Kwak et al. 2015 Packendorff & Lindgren 2014). Interestingly, this is not just a one-way shift; project management theories and practice are being introduced into organisational management studies as well! Burke & Morley (2016) and Müller et al. (2014) are some of the well cited studies that investigate the 'temporary organisation' vs. the 'permanent organisation'. The 'temporary organisation' draws its theories from the characteristic temporality of projects which binds the institution to a finite time period. Other subject matters also investigated in these studies include task, team, and trust issues given the high turnover nature of the project-like environment of the temporary oragnisation. The overall effect of all these different amalgamations of project and organisation has created a far-reaching aura of an organisational ontology in project management studies, which in turn subconsciously and effectively furthers the association of several principles of organisational knowledge management with project knowledge management.

While this binding of organisational ontology with project ontology is progressive in terms of exploring radically different ways of management, it makes it impossible for project knowledge management as a bounded self-referential discipline to be identified. There are always elements of organisational knowledge management within that distort the unique characteristics of project management. A knowledge management discipline exclusive to the unique characteristics of project and project management must be given a chance to demonstrate itself. For these reasons, the adopted theory of project management is the traditionally recognised definition best described by PMBoK as "a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates that a project has a definite beginning and end" (PMI 2013). The instrumental, temporary natured, triple constrained, and endeavour-oriented characteristics of projects (elegantly described in Geraldi & Söderlund 2016 and Cicmil 2006) opens up many doors for knowledge management to be interpreted idiosyncratically for project management; one of which being the distinctive features of the project life cycle. The standard life cycle of a project runs through overlapping interactions of initiation, planning, execution, monitor and control, and closure, with the dominance of named processes respectively at each stage.

There are of course many variations of practices and interpretations of the project life cycle and so the conceptualisation of these five standard processes is to some extent flexible. In any case, the project life cycle concept makes one subject very characteristic to project management: the whole of the project is extensively planned, arranged, and decided upon from the outset of the project and is recorded in documents such as the project charter, project scope, work break structure, budgeting, quality control, communication matrix, risk management, procurement plan, and responsibility and resource allocation, amongst many other project tools (Carstens et al. 2013). The project cycle is usually combined with feedback and response mechanisms for issues that arise here and there, which includes tools such as critical path analysis, critical chain analysis and PERT charts. Even for projects with growing constraints, studies such as Abuwarda & Hegazy (2016) offer various flexible solution optimisation frameworks that can adapt to the changes to achieve the project milestones. This means that unlike the criteria for a prosperous organisation, knowledge is not predominantly created to push away constraints; rather, it is being evolved to efficiently meet constraints. In other words, while a powerful organisation is one that grows outside its industry to engulf more markets (Nonaka, Toyama, & Konno 2000), a powerful project is one that effectively and efficiently meets its planned boundary to deliver on budget, scope, and time. How does that reflect on knowledge management in either institution? There is of course a co-existence of knowledge exploration and knowledge exploitation practices in both projects and organsations. But each given their unique being and ultimate purpose, where exploration practices overtakes exploitation practice in organisations aiming to introduce new products and services to more countries; exploitation practices overtakes exploration practices in projects aiming to realise and materialise the project without going beyond defined constraints. For project knowledge management, this draws attention to four very specific knowledge management effects: 1. All knowledge essential for project completion is created and decided on at the outset; 2. Existing knowledge from the outset is what dominantly directs and guides new knowledge creation; 3. Newly created knowledge is being assimilated into the pre-existing knowledge by means of unlearning inadequate knowledge as well as integrating with prevailing knowledge simultaneously; and 4. All knowledge and lessons learnt from a project are only fully elucidated and complete at the end of the project life-cycle, and can be used later for other projects.

These four knowledge management effects makes it clear that superimposing Nonaka & Takeuchi's (1995) knowledge creation spiral of the SECI model on project life cycle is clearly not appropriate. The knowledge creation spiral of the SECI model starts by circling away from a centre which symbolises a new and innovative idea by an individual, and ends by circling outwards from itself to grow outside its borders and constraints. In a project setting this makes no sense because a project starts with the whole lot of knowledgeable stakeholders and ends by meeting at the point where the constraints are defined rather than outgrow them. There is obviously a need to revise the knowledge spiral of a knowledge management model exclusive to project environments. This spiral is part of the Knowledge-Evolving Project and is referred to as the knowledge evolving spiral. There are three important implications to take note of here; firstly, knowledge evolution does not mean that external knowledge sources aren't explored, rather, that all relevant knowledge sources, external or internal, are primarily guided by a predefined knowledge base with the objective of evolving it. It is a matter of the power of influence of established knowledge. Knowledge creation by using knowledge sources external to the project can and does occur (Gasik 2011). Clearly, channeling external knowledge sources by cross-project learning is often said to be a characteristic feature of project management (Hartmann & Dorée 2014). Secondly, knowledge evolution should not be confused with the concepts of knowledge assimilation, knowledge integration, and knowledge absorption; these are all separate processes or sub-processes meant to build on previous knowledge and then make it common throughout the organisation. Knowledge evolution is more effectively understood as a complete cycle rather than a single process. It necessitates the dominant engagement of previous knowledge to evolve all the way up until the completion of the project. Thirdly, the knowledge evolving spiral is a spiral that represents the development of knowledge as it evolves in terms of effectiveness and immediacy for use, unlike the knowledge creation spiral which represents the progression of knowledge as it grows outside the organisation.

A Practical Model for the Knowledge-Evolving Project

As according to the theory of the knowledge-evolving project, the knowing acts involved (the actual practices that are exercised to attain knowledge) must be predominantly of an exploitative nature; they are meant to develop the existing predefined knowledge base more than they are meant to explore new ones. This is an absolutely significant discovery that justifies and orients the researcher to explore knowledge exploitation acts rather than knowledge exploration acts in project environments during the empirical stage. Knowing acts in general also have a pragmatic character that makes them an inherent practice in project management; i.e. they are applied but are not explicitly identified and established as such, being what Argyris & Schön (1974) call a theory-in-use. The methodology used in this thesis to explore the knowledge evolving (exploiting) acts is hence Glaserian Grounded Theory (a.k.a. classical grounded theory) since grounded theory emphasizes discovery of existing intrinsic practices. The empirical research study is conducted in a local real estate company in the United Arab Emirates which is part of a group of companies, and owns three buildings in Sharjah, U.A.E, with the main building, where the management office is located, being a small mall. The project which this thesis explores is the 'Maintenance Digitisation Project' which aims to convert to digital media all maintenance data and operations by implementing a Computerised Maintenance Management System (CMMS). The study covers three project phases: definition and initiation, selection and planning, and pre-implementation.

Due to the restriction not permitting use of electrical devices (such as recorders or cameras) for the research as requested by the managing director of the company, data collection was applied by field noting following primarily the guidelines written by the field ethnography researchers, Emerson, Fretz, & Shaw (2011). Raw notes were jotted down as incidents occurred, and as soon as possible afterwards, expanded in writing on the computer. In time, as the researcher gained experience, raw notes turned from jottings to big sentences to paragraphs, all the while simultaneously and separately recording memos both during the empirical research and after. Careful alternating between 'research mode' for detachment and objectivity and 'employee mode' for involvement and immersion was exercised throughout the research based on the guidelines recommended by Glesne (2011). Data collection and data analysis were cyclical and not consecutive during deployment of the primary methodology (grounded theory research). The secondary methodology deployed after grounded theory for triangulation, was qualitative document analysis, and followed by further consecutive data collection and analysis. Unlike grounded theory, qualitative document analysis is a relatively recently established research methodology for the management disciplines (although it has a rich history of being applied in other humanities fields such as literature, law and politics), and encompasses more than content analysis and thematic analysis. The context, history, authors, purpose, and target readers are among the aspects explored and analysed. The final results of the research are based on saturated grounded theory, triangulated by document analysis. The end products of the empirical study are the four distinctive knowledge evolving acts that constitute the knowledge-evolving project.

Finally, by augmenting the philosophy, theory, and practice of the knowledge-evolving project, a full scale model is built. The FRDA model (short for *formalisation, realisation, deconstruction,* and *assimilation*) of the 'Knowledge-Evolving Project' is the reverse of the SECI model (short for *socialization, externalisation, combination*, and *internalisation*) of the *Knowledge-Creating Company* (Nonaka & Takeuchi 1995*)*. Where the SECI knowledge spiral circles outwards towards engulfing more industries and markets, the FRDA knowledge spiral circles inwards towards the centre which represents meeting project constraints efficiently and effectively. Where the SECI knowledge spiral starts with innovative individual, the FRDA knowledge spiral starts with the whole group of knowledgeable stakeholders. Where the SECI knowledge spiral circles outwards forever representing a lasting organisation, the FRDA knowledge spiral circles inwards towards zero representing a finite project life. However, unlike the SECI model, the FRDA model acknowledges the ability of A.I. to create and manipulate knowledge autonomously.

1.3 Identifying the Gap in Literature

For each of the three essential anchors of the foundation of the Knowledge-Evolving Project – the philosophy, the theory, and the practice –, there exists a gap in literature. First philosophically, it is clear from the classification of mainstream knowledge management publications (Schultze & Leidner 2002, Spender & Scherer 2007, Jakubik 2007 and Ragab & Arisha 2013) that after almost three decades of academic dialogue and research to solve the mystery of knowledge existing independently of the knower, the 'entative perspective' vs the 'processual perspective' argument has touched dead-end (Newell 2015). The entative perspective on knowledge is self-contradictory and the processual perspective on knowledge is too perplexing and impractical. Scholars who approach this mystery using social theories of knowledge are facing the same deadlock as well. Knowledge occurring outside individuals was attributed initially based on social interaction (Bhatt 2001, Nonaka & Nishiguchi 2001, and Chen & Huang 2007), and later, on material agency (Orlikowski & Scott 2008, Carlile et al. 2013, and Brainin & Arazy 2016). It is a frustrating paradox of project knowledge management that very little debate and inquiry is available on this topic. The struggle with knower-independent knowledge is the first and one of the major gaps this research thesis addresses. By adopting Sagan's (1977) proposition that demonstrates how knowledge and knowledge work can be carried out by artifacts independent from human involvement, the concept of 'knowledge' is substituted for 'intelligence' thereby moving the emphasis away from a knower-independent knowledge to a knower-independent intelligence.

The second gap this research thesis addresses is theoretical; the foundational difference between project knowledge management and organisational knowledge management in literature is very faint and blurred. This is mainly because of two reasons: first, mainstream knowledge management is rooted in Nonaka's (1991) *Knowledge-Creating Company* which, as the title suggests, is an organisational study; and second, projects are being redefined from a 'temporary endeavor' to ' a temporary organisation' by highly influential project management scholars. By engaging in critical analysis about the organisational ontology of projects and the classical ontology of projects, the study will demonstrate how, remarkably, project knowledge management is actually the exact opposite of organisational knowledge management. This is established as the proposed 'Knowledge-Evolving Project' vs. Nonaka's (1991) *Knowledge-Creating Company*.

The final gap of the study is practice-based. Most of the knowledge processes and knowing acts debated in scholarly publications concerned with project knowledge management are directly absorbed from mainstream (organisational) knowledge management. There are hardly any debates in the literature about knowledge processes or knowing acts that are idiosyncratic to project knowledge management. Using the theoretical orientation of the Knowledge-Evolving Project, the study will draw the justification and rationale to observe and study particular knowledge exploitation practices – the knowledge evolving acts.

To summarise, the gaps to be addressed are:

1. The philosophical orientation that solves the mystery of knower-independent knowledge.
2. The foundational difference between knowledge management in organisations and knowledge management in projects; and therefore, the Knowledge-Evolving Project vs. the *Knowledge-Creating Company*.
3. The knowledge evolving acts of project knowledge management.

1.4 Research Purpose & Contribution to Knowledge

While 'entative' knowledge is the view of knowledge that is always in the state of being, 'processual' knowledge is the view of knowledge that is always in the process of becoming. Unfortunately, instead of untangling the epistemological complexities of knowledge management studies, the entative vs. processual knowledge debate has further confused knowledge management so that knowing acts, processual knowledge, social theories, and knowledge theories have become impossibly indiscernible and lacking in pragmatic use. Moving past this philosophical knot by introducing a new theory of knowledge – the evolution of intelligence – is the first contribution this research thesis makes to project knowledge management and knowledge management in general. The second major contribution is the conception of a theory of knowledge management exclusive to project knowledge management. This is done by deconstructing deep rooted elements of organisational knowledge management in project knowledge management. This deconstruction reveals the third contribution to knowledge management studies in general: project knowledge management is essentially the opposite of organisational knowledge management. The second and third contribution provide the justification and rationale for the fourth contribution: the establishing of knowledge evolving acts in project knowledge management literature by exploring them empirically in a project environment. The fifth and final contribution is the FRDA model and its knowledge spiral; a knowledge management model that makes sense only to project knowledge management.

1.5 Research Scope & Significance

The first scope set to consider is of a philosophical nature, and is meant to guide the epistemological critique of the mainstream knowledge management riddle of 'personal knowledge'. The scope divides the literature on knowledge management epistemology into the context of ‘entative’ vs. ‘processual’ knowledge. Other grand epistemological divisions such as the exogenic vs. endogenic (Oluikpe 2015) or mode one vs. mode two knowledge (Wood 2002) are not considered. The second scope set is also philosophical, and is meant to give a chance to as much epistemological and conceptual ideas of knowledge as possible. It categorises knowledge management philosophies into ‘knowledge theories’ (ideas contemplating the interaction of the mind with different knowledge sources) and ‘social theories of knowledge’ (ideas explaining the rise of knowledge as a product of social interaction). The third scope set is theoretical in nature. The study will adopt the traditionalist ‘classical ontology’ of projects and project management from the various project management bodies of knowledge, such as APMBoK and PMBoK, which define project management as a bounded terminal endeavour with a characteristic life cycle. This will provide a crystal clear decoupling of a ‘project’ from an ‘organisation’, and protect the unique characteristics of projects. The fourth and final scope set is empirical in nature. The debates and discussions on the ‘knowledge-evolving project’ during the literature review is not used to create a framework or a model since that would violate a major premise of grounded theory research. Instead, they are used to inform the adoption of a philosophical, theoretical, and practical orientation which provides the rationale and justification of exploring the knowledge exploitation acts in projects when immersed in conducting the empirical research for the thesis. The significance of this research can be deduced from all of the four scope sets; one, it introduces an epistemology that acknowledges the possibility of knowing by an intelligence independent from consciousness; two, it defines and describes a knowledge management theory and practice idiosyncratic to project management; and three, it establishes the knowledge evolving acts – Inscription, Technological Extension, Discussion, and Redundancy – and advances their strengths for theoretical review and practical application.

1.6 Main Aim, Objectives, & Research Questions

The main aim of this doctoral thesis is to explore and study the different ways by which human and nonhuman intelligence develop and build on the guiding knowledge that has been predefined at the project outset in a knowledge evolution spiral; in simpler terms, the knowledge evolving (exploitation) acts. For these different knowing acts to be appropriately justified, a philosophical, theoretical, and practical orientation will be instituted during the literature review. This orientation is called 'the knowledge-evolving project' and is readily described as the opposite of *The Knowledge-Creating Company*. At the conclusion, the knowledge evolving acts empirically explored will be augmented with the knowledge-evolving project philosophical, theoretical, and practical orientation and justification to construct the final knowledge-evolving project model – the FRDA model which is the opposite of the SECI model. The FRDA model is essentially the management model of the knowledge-evolving project. At each level of the subject matter of the knowledge-evolving project – philosophy, theory, practice, and empirical investigation – new insights would have emerged. These insights contribute not only to project knowledge management, but to knowledge management in general. The following divides the main aim into 6 statements of objectives in the order which appears in the thesis:

- Demonstrate how project knowledge management in the current literature is in its foundation an organisational knowledge management discipline and hence denies the unique characteristics of project and project management its full consideration.
- Examine the philosophical difficulties associated with the established mainstream knowledge theories rooted in the *Knowledge-Creating Company*. Introduce an alternative

theory of knowledge that contains no such epistemological puzzles. This will make the philosophical background for a full project knowledge management discipline.

- Deconstruct project knowledge management from organisational knowledge management by differentiating between the classical ontology of projects and an organisational ontology of projects. Demonstrate therefore how the *Knowledge-Creating Company* is the opposite of the proposed ‘Knowledge-Evolving Project’.
- Discuss how the knowledge-evolving project reflects on knowing acts and the knowledge processes involved and demonstrate how these knowing acts and knowledge processes entail epistemic relativism
- Explore and investigate the knowledge evolving (exploitation) acts involved in a classical project context using the orientation of the ‘Knowledge-Evolving Project’.
- Augment the knowledge evolving acts discovered during the empirical investigation with the philosophical, theoretical, and practical discussion of the knowledge-evolving project. This will be used to construct the final FRDA model which is essentially the management model of the knowledge-evolving project.

Based on the aforementioned objectives, the following research questions were constructed:

1. Why is the current literature on knowledge management in project management a problem for constructing an idiosyncratic project knowledge management theory? What approach should be taken to deconstruct project knowledge management from its organisational knowledge management roots?

2. What are the common problems associated with the knowledge philosophy of organisational knowledge management? What alternative epistemological approach could be adopted to dissolve this complexity? Why is this important for a project knowledge management discipline?
3. How can a theoretical account of a classical ontology of projects and organisational ontology of projects be used to deconstruct organisational knowledge management from project knowledge management? What does it reveal about the *Knowledge-Creating Company* and the 'Knowledge-Evolving Project'?
4. What are the knowing acts and the knowledge processes of the knowledge-evolving project? Why do they entail epistemic relativism?
5. What are the knowledge-evolving acts? How are they manifested on the grounds of project context?
6. What is the resultant management model when augmenting the knowledge-evolving project orientation with the empirically explored knowledge evolving acts?

1.7 Research Strategy

As far as this research thesis is concerned, the scope of the empirical research is to explore the naturally occurring and intrinsic knowledge evolving acts as they occur during the digitisation project in a real estate company, and to establish them as generalised knowledge practices in the project management literature. Reasonably then, the nature of this investigation is exploratory, inductive, and qualitative; exploratory because the knowledge evolving acts have not been defined in literature, inductive because they are being discovered and established rather than tested and validated, and qualitative due to their incommensurability and ad hoc nature. Exploratory, inductive, and qualitative inquiries are a suitable candidate for grounded theory research. To draw the full power of the flexibility and independence provided by grounded theory, the research deploys Glaserian Grounded Theory (GGT), which unlike Straussian Grounded Theory that stresses on theory generation, emphasises theory discovery. Data collected for GGT analysis was by field noting following the guidelines and strategies presented by Emerson, Fretz & Shaw (2011). Over a period of five months, data collection and data analysis were cyclical and impromptu, each iteration drawing the study closer and closer to saturation and the definitive results.

Once the knowledge evolving acts were discovered and saturated, a secondary methodology, qualitative document analysis, was deployed over the course of one and a half months for triangulation and theory validation. Qualitative document analysis (or simply document analysis) is a relatively unfamiliar research methodology in the business and management literature. Documentation use in research mostly points to document collection, with document analysis being a separate content or thematic analysis method. A complete document analysis methodology comprises more than that; it is an iterative compounding process of thematic and content analysis with elements drawing from methods such as narrative analysis, frame analysis, tropological analysis, and discourse analysis, all the while paying careful attention and maintaining a watchful awareness on the context of the documents' use, authors, intentions, sources, flow, and creation period, among many other such criteria (Bowen 2009). The term 'qualitative' introduced in 'qualitative document analysis' doesn't mean that it is strictly qualitative; rather, it is to define and describe document analysis as a whole standalone qualitative methodology. Qualitative document analysis is used as a separate methodology to methodologically validate and triangulate (Bryman 2004; Denzin 2009) the saturated results obtained from GGT research. It is therefore deployed sequentially after grounded theory results rather than in parallel during grounded theory research.

A little over 90 documents were collected and analysed against the results yielded by grounded theory research. These documents comprised a variety of types concerning the digitisation project, such as software vendor companies' proposals, project committee email chains, minutes of meetings, and even rough notes by the various project stakeholders. The documents collected and analysed were those that were created before, during, and after the primary research methodology.

1.8 Thesis Dialogue & Flow

This thesis addresses an extensively wide array of topics and subject matters related to knowledge management in project management in order to attain an ideal and abstract generalisation at the highest level on a full theory of project knowledge management, independent of context. The research thus involves much theoretical, philosophical, and technical concepts and terminologies drawn from different fields of studies that consider the topic under discussion. To communicate with scholars and professionals from different backgrounds of project management, this study includes a glossary of terms for reference. In addition to this particular effort undertaken to ensure that the argument of the thesis is easily comprehensible, a constant comparison is made of the 'Knowledge-Evolving Project' with its opposite Nonaka & Takeuchi's (1995) *Knowledge-Creating Company*. The *Knowledge-Creating Company* covers the iconic SECI (Socialisation, Externalisation, Combination, Internalisation) model and its knowledge creation spiral. The fact that it is iconic makes it a well-known model among the project management community and hence it is advantageous to use in explaining a familiar concept that is its opposite. The tertiary and final effort is in the manner with which this thesis is structured. The Literature Review chapter commences with an opening statement that demonstrates how most project knowledge management publications are grounded in organisational knowledge management. The thesis will next propose to deconstruct project knowledge management from its organisational beginnings by dividing it into three subject matters: philosophy, theory, and practice. The philosophical discussion will attempt to adopt a more practical and more technologically relevant epistemology rather than the current mainstream knowledge management philosophy of ‘tacit knowing’. The insights revealed will prepare for the following discussion that will theoretically deconstruct project knowledge management from organisational knowledge management. This pure project knowledge management theory is identified as the ‘Knowledge-Evolving Project’. The knowledge-evolving project will next provide the justification and rationale for the Methodology and Findings chapters to empirically investigate knowledge-exploitation acts in a project setting. The results, along with the philosophical and the theoretical discussions of the knowledge-evolving project, will be used in the Discussion chapter to build the FRDA model, which is essentially the management model of the knowledge-evolving project.

CHAPTER TWO: LITERATURE REVIEW

2.1 Project Management & Knowledge Management

Even though it's renowned as a modern institution, project management was not exactly a new concept to the minds of the ancients; the top hundred list of mankind's projects include the pyramids of Giza, the Colossus of Rhodes, the Gardens of Babylon, and the Great Wall of China. Through the ages, project management, its elements, its boundaries, and its capabilities evolved in complexity with the ambitions and desires of mankind, allowing for more impossible accomplishments like the Apollo moon landing projects, the construction of an underground 50 meters deep 27 kilometers circumference circular particle collider, and the massive international coordination of FIFA World Cup programme projects. Project management continues to create significant contributions to the global economy spurring developments through all levels – individual, group, organisational, and even societal. Primarily driven by the triangular constraint concept of budget, scope and time, project management is classically defined as the practice of systemisation and application of processes, tools, methods, techniques, skills and knowledge, to complete a project successfully (Project Management Institute 2013). Currently, there is a well-established consensus – among scholars and practitioners alike – that project management has grown beyond its classical reach to cover operations that lie past the projects' jurisdiction; horizontally stretching backwards from pre-planning all the way past post-completion of the project life cycle(s), and vertically zooming outwards from program and project portfolio management.

Project management has absorbed a diversity of fields that contributed to its development over the ages. During its early years, the 1940s -1960s, project management was shaped and defined in the image of the then highly prominent industrial age engineering and scientific disciplines, resulting in a paradigm that focuses on hard skills, reductionist methods, instrumentational rationality, and technical solutions (Cicmil & Hodgson 2006; Gustavsson & Hallin 2014). The following years (1970s-1990s), project management witnessed a social shift in its paradigm due to the proliferation of novel socio-economic fields such as organisational behaviour, game theory, logistics, and strategic management. Subsequently, project practices and operations that assumed universal linear processes and techniques such as project life-cycles, work breakdown structures, and pre-planned tasks became re-modelled into iterative, adaptive, contextual and flexible processes that acknowledge the complexity and dynamics of projects (Cicmil & Hodgson 2006, Winter et al. 2006). The future of project management studies according to Geraldi & Söderlund (2018) is looking at more radical new reforms of 'organising' projects as opposed to merely 'managing' them. This echoes the growing consensus among project management scholars who favor a kind of organisational ontology of project management and project practice best explained by Andersen (2008).

One of the remarkable events that was central to expanding project management studies during the 1990s was the then extensively captivating field of knowledge management. First popularised by Nonaka (1991) who borrowed Polanyi's (1958) concept of 'tacit knowing', knowledge management, in its purest form, is a discipline that underlines the significance of the natural subjective intellect and the means to manage it to bring about competitive and strategic advantage. This unusual approach offers project management peculiar strategies and techniques that secures acquisition, assimilation, dissemination, and application of knowledge among the knowledge workers within projects; subsequently resulting in enhanced environment for innovation, superior decision-making skills, better planning and control, improved stakeholder management and leadership skills, and better research and development practices (Levin 2010). If project management was a story, knowledge management would have been introduced in the chapter where it was first acknowledged that pre-given knowledge determined at the outset of a project, such as resource allocation, risk assessment, and implementation plans, is always partial and incomplete, especially in the case of complex projects (Engwall 2002). As projects emerge through their lifecycles, the numerous complexities, uncertainties, and concerns appear, and with them the requirements to revise, renovate, and modernise the knowledge outlined at each previous successive stage of the project (Daniel & Daniel 2017; Ahern, Leavy, & Byrne 2014). Thus, knowledge management is a powerful and essential enterprise to engage in for achieving a successful project through all its complexities. The competitive advantage and valuable impact that knowledge management theory and practice offers to project management is a topic easily found in literature no matter whether the topic is on project management or on the nature of projects; from construction (Serpella et al. 2014; Yun et al. 2011), to R&D (Sándor Lipusz et al. 2006; Akgün et al. 2005), and to I.T. (Park & Lee 2014: Yang, Chen, & Wang 2012) etc. and from project teams (Fedor et al 2003), to leadership (Liebowitz & Megbolugbe 2003), to communication (Fernie et al. 2003), and to success factors (Lindner & Wald 2011) etc. Some scholars even prefer analysing project management comprehensively as a knowledge-based practice (see Todorović et al. 2015 and Akbar & Mandurah 2014).

The philosophical, theoretical, and practical foundations of mainstream knowledge management mainly revolve around the management of the dynamics of interaction between the two types of knowledge: the tacit and the explicit. Explicit knowledge is the kind of knowledge that is codified and objective, hard and clear, easy to store and transfer – examples include technical information and material properties. Tacit is often defined in the literature as the antithesis of explicit. It is the kind of knowledge that is personalised and subjective, soft and cognitive, hard to store and transfer (Koskinen, Pihlanto & Vanharanta 2003). It includes the aspects of experience, schemata, beliefs, and deeply rooted perceptions and world views. The conventional management approach to knowledge management is the cyclical transformation of the two knowledge forms in a continuous spiral of socialisation (tacit to tacit), externalisation (tacit to explicit), combination (explicit to explicit), and internalisation (explicit to tacit); the renowned SECI model. The major publications on knowledge management that followed over the next ten years following Nonaka's (1991) popular SECI model include the works of Wiig (1993) on organisation of knowledge in a semantic network; Nonaka and Takeuchi (1995) on circulation of knowledge within organisations through tacit/explicit transformations; Leonard-Barton (1995) on the emphasis of behaviour and emphatic design of knowledge; Stewart (1997) on intellectual capital and its practical application in the information age economy; Sveiby (1997) on running and measuring knowledge based assets; Davenport & Prusak (1997) on knowledge as a powerful competitive resource and how to sequentially leverage it; Wenger (1998) on understanding knowledge through communities of practice, and Argote (1999) on organisational learning and knowledge depreciation. Since the millennium, knowledge management – its philosophy, its classifications, and its characteristics – has been discussed widely and extensively in the literature: being reviewed as an objective, defined asset (Harlow 2008) as well as a subjective social phenomenon (Bosch-Sijtsema & Hendriksso 2014); a micro perspective (Whyte et al. 2008) and a macro perspective (Levin & Rad 2007); a codified approach (Bettiol, Maria & Grandinetti 2012) and a personalised approach (Koskinen & Pihlanto 2008); a distributed activity (Desouza & Evaristo 2004) and an integrated activity (Zeleny 2013); a generic model (Crawford & Pollack 2007) and a universal model (Koskinen, Pihlanto & Vanharanta 2003).

By now a sharp eye would have noted how most (if not all) of these foundational works of knowledge management originate from the knowledge management *of organisations.* The roots of mainstream knowledge management, in its entirety, is an organisational study. Knowledge management has made its way into other management fields already moulded by the hands of organisational scholars and practitioners. It is hence difficult to find a knowledge management standard proposed for project management without trickle down elements and philosophies from organisational knowledge management (see for example Handzic (2017) and Pemsel & Wiewiora (2013)). Indeed, most full-scale books on project knowledge management such as Von Wasielewski (2010) and Koskinen & Pihlanto (2008) prefer to include an organisational aspect as an integral part of their review. More frustratingly so, it is difficult to find a self-claimed fully bounded project knowledge management doctrine that perseveres the unique characteristics of projects and project management. This is perhaps most evident in Gasik's (2011) highly cited study that attempts to create a complete project knowledge management model exclusive to project management. Gasik (2011) aggregates all of the familiar concepts of organisational knowledge management into a project micro-knowledge (task level) configuration, and a project macro-knowledge (organisation level) configuration that secures the knot between organisational knowledge management and project knowledge management rather than dissolve it.

The knot between project knowledge management and organisational knowledge management can be broken-down into three subject matters; the philosophical foundation, the theoretical foundation, and the practical foundation, all of which conveniently found in the gospel of organisational knowledge management – Nonaka's (1991) *Knowledge-Creating Company*. Using centrally Nonaka's (1991) work, the thesis study will deconstruct organisational knowledge management from project knowledge management. First, philosophically, the difficulties associated with the epistemology of tacit knowing has been debated plenty in literature for over thirty years with no real solution to the paradox of the independently existing knowledge. It is not wise to instinctively adopt them into a project knowledge management discipline just because they make up most of the mainstream knowledge management material. An alternative philosophy of knowledge should be adopted to project knowledge management. This will effectively sever the philosophical knot between knowledge management in organisations and knowledge management in projects. Second, theoretically, the organisation management maxim that requires the organisation to use knowledge to grow beyond its constraints doesn't make sense to project management. Projects need to meet constraints rather than deliberately outgrow them. The SECI model with the knowledge creating spiral that circles outwards from the organisation cannot be superimposed on a project life cycle. This critical argument will sever the theoretical knot. Finally, practically, the knowing acts and knowledge processes of the knowledge creating-company that encourage the exploration of radically new knowledge does not work on a project setting that is intended to develop and evolve the predefined existing knowledge base as the project emerges. In a project setting, knowing acts related to knowledge exploitation should be highlighted and acknowledged as the base make-up of the knowledge processes of project knowledge management. This will sever the practical and final knot between organisational knowledge management and project knowledge management and provide the justification and rationale for the empirical study to research knowledge exploitation practices. The following sections will break up each of the three subject matters in that order – philosophy, theory, and practice – and provide a detailed review on them.

2.2 Mainstream Knowledge Management Philosophy: The Tacit Dimension

The Coming of the Tacit Knowledge

The discipline of knowledge management in its entirety officially began when Ikujiro Nonaka – a Japanese scholar and expert of management study and practice – published an article in the Harvard Business Review titled *The Knowledge-Creating Company*. In this article, Nonaka details the concept and philosophy of tacit knowing; a theory of knowledge he borrowed from chemist turned epistemologist Michael Polanyi who famously declared that 'we know more than we can tell' (Polanyi 1958). Romantically speaking, the tacit dimension of knowledge is what single handedly initiated the massive discipline of knowledge management as we know it today (Crane & Bontis 2014). In actuality, however, Nonaka's effort was not isolated; years of concepts and theories from OD and organisational learning paved the way for *The Knowledge-Creating Company*, most notably the notion of the 'knowledge worker' from Drucker's (1988) *The Coming of the New Organisation*. To Nonaka and colleagues in the early 1990s, knowledge is either expressible (known as explicit knowledge) or impossible to articulate (known as tacit knowledge), with a grey area in between that is 'difficult to articulate'. Knowledge management's oft propounded unquestionable decree is that knowledge and knowing is an exclusively human activity, and organisations should harness the power of the bringers of knowledge rather than the knowledge itself. Knowledge management is hence logically comparable to information management where information itself captures the focus of management more so than those who maintain and run the information. With all of the novel competing concepts and ideas discussed in the literature on knowledge management literature, the fundamental principle of the concept of tacit knowledge still stands; that all things considered, knowledge is ultimately personal and subjective. The existence of knowledge independent of the knower an illusion made possible by symbolic representations and durational flow among other things (Bergson 1998). Yet the written word plainly has major knowledge related consequences in knowledge management and almost everywhere else.

Unlike project management which was already well defined and officially practiced, knowledge management opened its eyes in the early 1990s. There are though some studies that contest this account such as Dalkir (2011) and Lambe (2011) who argue that knowledge management has its historical roots further back during the 1960s. Nonetheless, the knowledge management as we know it today that is being debated across the various disciplines of management studies was popularised by none other than Nonaka (1991). At present, knowledge management has witnessed development within two major schools of thought: the late postmodern entative view and early post postmodern processual view of knowledge. Both philosophical perspectives were articulated to resolve the epistemological query of 'where knowledge exists' and the problem of 'how to externalise it'. The entative perspective would tell us that knowledge exists at fixed points in space-time that one comes to physically face (Wood 2002; Styhre 2003; Mingers 2008). A conclusion of this assumption that is noteworthy is the fact that knowledge can exist beyond knowing, within archives, systems, communities, individuals, or social settings as tacit, explicit, implicit, self-transcending, information, data, embodied, embedded, or encultured (Nonaka & von Krogh 2009; Byosiere & Luethge 2008; Williams 2006; Fuller 2002; Scharmer 2001; Wenger 1998; Blackler 1995; Nonaka 1994; Brown & Duguid 1991). Such a configuration of knowledge independent of observation obliges it to be passive as end-states, susceptible to apprehension, and strictly distinctive. This view fits very well with knowledge-as-a-commodity approaches in management. Nevertheless, it violates the principle of the tacit dimension on which knowledge management is built, which defines knowledge as an exclusively subjective personal ability. In the words of Polanyi (1969, p. 195) “All knowing is tacit or grounded in the tacit”. The entative view of knowledge has been traced and credited to our visual prejudice in the sciences (Toit 2003). When knowledge is available somewhere ontologically, it often is stable enough to be managed. Yet, time and again it has been shown that knowledge is not as stable as most project management techniques would have them be. For instance, project knowledge transfer processes embody the assumption that knowledge needs to physically ‘reach’ individuals through codification or socialisation; a postulation implicitly based on the notion that the world is fundamentally immobile and in stasis (Wood 2002). The underlining supposition of ‘reaching somewhere’ is one of an ontological character that requires knowledge to be a ‘stock’ of tacit or a ‘body’ of codified knowledge, or a ‘base’ of information that travels between two discrete spatial points. It therefore comes to no surprise that knowledge forms so often suffer from issues of conceptual and practical demarcation (Styhre 2004).

Addressing this paradox of managing ‘entative’ forms of knowledge that can exist only as part of the knower, and yet also persist somehow external to them, are two camps: those that deal with the dilemma of knowledge transformation from one form to another (such as Nonaka’s (1991) SECI model), and those that deal with the dilemma of separating the different means of epistemological access (such as Wiig’s (1993) Knowledge Management Matrix). What follows then in managing knowledge in projects are the ontological based processes of acquisition, storage, retrieval, and transfer of knowledge forms which are underlined by their communicative approaches and taxonomic techniques. It is thus habitually assumed that when one comes to a knowledge source during a project lifecycle – a user manual, or a how-to video, or a conversation on the project scope – they will acquire it simply because it is available. In practice this is far from true (Bresnen et al. 2003; Schindler & Eppler 2003). Individuals wrestle with knowledge sources to comprehend them, and in their interpretation, often create new understandings (Styhre 2003; Toit 2003). This struggle to understand and create new understandings is recognised in knowledge management, and proponents of the 'entity' approach of knowledge often cite social theories in order to relay this intellectual fallacy more persuasively. The result is often more philosophical complexities and loopholes.

During the early 2000s, a new approach to tacit knowledge was gradually becoming more recognised in the knowledge management community. This is the 'processual' knowledge view (Shin, Holden, & Schmidt 2001; Kakihara & Sørensen 2002; Chiva & Alegre 2005). The epistemological processual view of knowledge is highly based on the Heraclitian principle of 'all is flux', and the best way to understand it is by drawing from Bergson's (1998) assertion that the things we study are the things that flow in time. Knowledge here is an amorphous occurrence that emerges only when *one observes it* regardless of whether it is represented alphabetically, graphically, or numerically. To processual knowledge philosophers, symbolic representations carry knowing triggers rather than literally possess 'meanings'. When one comes upon a symbolic representation (for example a guide manual), by reading their contents they activate knowledge capabilities within, which in turn gives rise to the shifting meanings along with supporting the illusion that texts carry meanings. The whole notion of knowledge storage is epistemologically challenged (Rowe 2005). What we perceive as knowledge stored and retrieved is actually knowledge in a constant state of creation and recreation as one comes to observe it. Ontological objects do not bound knowledge; rather, knowledge is a series of occasions, a happening that constantly emerges, a repetition of former self, an ever-incomplete unfolding structure of absence, an explosion and mutation of resemblance (Knorr 2001). As for knowledge moving ontologically between two space-time points, Deleuze & Guattari (1988) remind us that knowledge disseminates like a rhizome rather than an arborescence; without direction and without center. It is like an infinite dictionary: for every word there are a set of words that describe it. There can never be a beginning word and an end word.

One can argue that the entative perspective on knowledge came instinctively rather than thoughtfully with the developments of the ideas of tacit knowledge. Knowledge philosophy was not exactly a matter that many knowledge management scholars discussed extensively, that effort was left primarily for Nonaka and a small group of colleagues. Classical knowledge management scholars such as Wiig (1993), Boisot (1995), von Krogh & Roos (1995), Davenport & Prusak (1997), and Weick (2001) were more interested in the social theories of knowledge which produced practical models. The philosophical paradox of knowledge existing outside the knower became a major topic of debate in the management studies literature only during the 2000s (Grant 2007; Mooradian 2005; Li & Gao 2003; Scharmer 2001; Von Krogh, Ichijo & Nonaka 2000) during which time the processual view of knowledge was slowly establishing itself in the knowledge management literature (Haider 2014; MacIntosh et al. 2012; Mingers 2008; Rowe 2005; Styhre 2004; Chia 2003). However, academic work on processual knowledge remained comparatively scarce with only a few studies adopting this view of knowledge. If processual knowledge could have solved the problem of knower independent knowledge, we need to understand why it did not become more of a mainstream idea in the knowledge management literature?

The Perplexing Processual Knowledge

Processual knowledge, with its incredibly complicated epistemology, resolves many of the philosophical difficulties associated with how knowledge can exist outside the knower. Its proposed solution is the dividing of knowledge and knower epistemologically rather than ontologically, thereby preserving the ability of the illusionary external knowledge to be in a state of constant flux. Some of the notable studies of knowledge management that investigate processual knowledge include Knorr-Cetina (2001), Wood (2002), Styhre (2003), Styhre (2003), Rowe (2005), Chiva & Alegre (2005), Mingers (2008), and Jakubik (2011). Processual knowledge categorizes knowledge into capabilities rather than forms; for example, propositional, experiential, performative, and epistemological (Mingers 2008), and declarative or procedural knowledge (Becerra-Fernandez & Sabherwal 2015). Even so, it can be argued that processual knowledge introduces more epistemological complexity and misconceptions than it resolves. One of the most troublesome of these is the misunderstanding and confusion over 'processual knowledge' and 'knowing acts' (see for example Cook & Wagenaar 2012). Processual knowledge as explained previously is the view that knowledge is in a *continuous state of flux* thanks to the observational abilities of the human mind that gives rise to it. It is a philosophical concept. Knowing acts on the other hand are the different practices carried out by individuals to attain knowledge, for example, sense-making and sense-giving (Rouleau 2005), reflection and praxis (Scharmer 2000), metaphor and imitation (Nonaka 1991), and know-how/know what (Quinn, Anderson & Finkelstein 1996). The confusion between processual knowledge and knowing acts started when Cook & Brown (1999) argued that if managing knowledge belongs to an 'epistemology of possession' school of thought, managing knowing belongs to an 'epistemology of practice' school of thought; the former pertaining to a entative view of knowledge and the latter to an understanding of knowing acts. To complicate things further, Cook & Brown's (1999) 'epistemology of practice' is different from Chia's (2003) 'knowledge as practice', which is a concept that favours knowing a posteriori (empiricism) over knowing a priori (rationalism). Gherardi (2000) is one example of studies that (knowingly?) confuses empiricism with 'epistemology of practice'. It's no surprise then that when Nonaka and colleagues attempted to integrate processual knowledge with entative knowledge (Nonaka & von Krogh 2009; Erden, Von Krogh & Nonaka 2008; Nonaka & Toyama 2005; Nonaka & Toyama 2003) they supposed that there is no difference between processual knowledge, knowing acts, and knowledge as practice. Their conclusion was that knowledge exists simultaneously in cognition as well as in action, with 'Ba' being the different epistemological places upon which respective epistemological actions are taken. It is by using dialectic thinking with 'Ba' appropriately that meaningful knowledge can be created, shared, assimilated, and stored. As mentioned earlier in this thesis, signature phrases such as 'here and now', 'context-specific', and 'phenomenological', which directs the analysis of processual knowledge are cited throughout this paper. But at the same time, they are confused with knowing acts and knowledge as practice such as in the concepts of 'dialogue', 'social interaction', and 'learning-by-doing'.

Is this confusion a consequence of the complication of processual knowledge, or because no distinction is made between knowledge theories and social theories of knowledge? Nonaka and colleagues' response to criticism (Nonaka, Tomaya, & Hirata 2008) offered to bridge the two paradigms, processual and entative knowledge, by a seemingly absent minded coalescence of knowledge theories and social theories of knowledge, consequently creating even more confusion in the understanding of processual knowledge. Strictly, knowledge theories are those questions contemplating the interaction of the mind with different knowledge sources; for example, focal and subsidiary awareness (Polanyi 1967), epistemic relativism (Feyerabend 1999), and intuition vs intellect (Bergson 1998). Knowledge theories tend to explore and examine subjective epistemological concepts such as truth, experience, and rationality. Social theories of knowledge on the other hand are those ideas explaining the rise of knowledge as a product of social interaction; for example, the social construction of knowledge (Berger & Luckmann 1966), language games (Wittgenstein 2010; Wittgenstein 1953), and symbolic interactionism (Meltzer, Petras & Reynolds 1975). Social theories of knowledge tend to explore and examine inter-subjective epistemological concepts in terms of languaging, construction of reality, and social interaction. There is within this a grey area mixing both theories but not to the point where it gets confusing. Tell (2004) for example makes a graceful distinction between personal knowledge and institutional knowledge by drawing from Polanyi's tacit knowing to explain the former and Wittgenstein's language games to explain the latter. A similar, insightful distinction is made in Ray (2009) between Polanyi's tacit knowing (subjective) and Glasersfeld's (2002) radical constructivism (inter-subjective).

Another naïve yet genuine confusion that advocates of concepts of processual knowledge make is of a semantic nature, although there is little evidence of its discussion in the scholarly literature. Nevertheless, it is sensible to address it. Processual knowledge is sometimes referred to as 'knowledge in the process metaphor' (Rowe 2005), where the words 'process' and 'processual' mean 'in a constant state of flux'. Processual knowledge draws its philosophy from process philosophers such as Bergson (1998), Whitehead (1978), and Deleuze & Guattari (1988). Processual knowledge is *not* 'knowledge processes', 'process-based knowledge' or (in some studies) 'process knowledge'; all different labels for knowledge management processes (Sarnikar & Deokar 2017; Andreeva & Kianto 2011; Chang & Ahn 2005). Knowledge management processes are the *de jure* set of implementations executed for a specific objective of knowledge management. For example, knowledge capture, assimilation, codification, transfer, and application, are all knowledge management processes (Gasik 2011). The previously mentioned knowing acts are in turn, the *de facto* practical implementation of knowledge management processes (Brown & Duguid 2000). In Nonaka & Takeuchi's (1995) SECI model of knowledge transformation, the SECI stands for the knowledge management processes of socialisation, externalisation, combination, and internalisation. The SECI blocks contain the knowing acts: experiencing, brainstorming, organising and editing, and reflecting.

It is no wonder that the perplexing ideas of processual knowledge never captivated the wider community of knowledge management scholars and practitioners. It is often considered philosophically too complex to discuss in the business management literature and can easily create theoretical confusion between knowing acts, knowledge management processes, knowledge theories, social theories of knowledge, and knowledge as practice. It is also often unfeasible to implement in practice; the idea of 'flux' knowledge doesn't ring well with managers. It is more pragmatic for academics to talk about creativity (Dong et al. 2017), innovation (Martín-de Castro 2015), and imagination (Spender 2008) in knowledge management rather than knowledge as a kind of flux. But then again, its substitute, the entative perspective of knowledge, is not theoretically sound or practically viable either (Lambe 2011; Bosch-Sijtsema & Postma 2009). Theoretically it suggests that knowledge can be externalised and yet cannot be independent of the knower, and practically it models a transformation of knowledge forms that are not even clearly divided. The next section will discuss in detail the philosophical and practical problems associated with the entative perspective on knowledge.

The Self Contradictory Entative Knowledge

The vast and divergent literature on knowledge management is apparently not enough; it still fails to live up to expectations in reality (Lambe 2011; Bosch-Sijtsema & Postma 2009). Crane & Bontis (2014) and Mingers (2008) are amongst the many scholars who argue that the problem is not so much a matter of the theory-practice gap as it is due to flaws within the fundamentals of knowledge management, or more ambitiously, knowledge itself. The literature on knowledge management is highly and absent mindedly concerned with entative knowledge forms that one comes to physically 'face'. The entative view of knowledge is, above all, characterized by its *end-state stasis*. These knowledge forms depend on their ontological position; for instance, tacit if within individuals, codified if within systems, encultured if within communities, and information if within archives. For managers holding such an ideology, reality and knowledge are one and the same thing: present and within grasp (Chia 1999). To Cook & Brown (1999), this 'epistemology of possession' cannot successfully account for the act of knowing. Regular knowledge management techniques such as codification, acquisition, storage and transfer become merely communicative and taxonomic devices meant to order and regulate definite knowledge entative forms (Wood 2002; Styhre 2003; Mingers 2008). Central to this epistemology of possession is the dilemma of knowledge transformation. Although knowledge conversion is a highly discussed topic in the knowledge management literature, it has been noted that these conversion practices do not directly relate to success (Mills & Smith 2011). Yet knowledge management of knowledge according to the 'entity' metaphor is highly concerned with conversion methods that transfer knowledge from one form to the next. What most writings on knowledge as entative forms fail to fully acknowledge is the dynamic, shifting and unpredictable nature of knowledge (Rowe 2005). Even when dynamicity is claimed, knowledge flows in an 'immobile motion' (Wood 2002); knowledge seems to be a passive end-state – a universal truth; submissive – susceptible to apprehension and strictly distinctive; it can exist in forms that are mutually exclusive (see for example Zhao, Lu & Wang 2013 or Štorga, Mostashari & Stankovic 2013).

The roots of entative knowledge management is Nonaka's (1991) SECI model which undertakes that objectification of knowledge into end-state 'entities' is not only possible, but merely a process of externalisation and socialisation. Probing further inside the SECI model reveals that the flaw lies in its philosophical interpretation of Polanyi's (1958) 'we know more than we can tell'. While Polanyi was a firm realist who believed that synthesizing subjective knowledge is impossible, Nonaka (1994) still claimed that the ineffable tacit can be 'externalised' into isolation and be made predisposed to presenting itself as fact to all those who wish to manipulate it (Ray & Clegg 2007). What's more, Nonaka's (1991) philosophical stance on knowledge is rather self-contradictory; his claim that 'truth is in the eye of the beholder' seems to bid no inhibition to his assertion that 'To convert tacit knowledge to explicit knowledge means finding a way to express the inexpressible'. It is as if personal knowledge is both relatively and universally true at once. It is not surprising therefore that the tacit/explicit dichotomy and later continuum (Nonaka & Toyama 2003; Nonaka & Toyama 2005; Nonaka & von Krogh 2009) along with other knowledge forms suffer major demarcation problems (Styhre 2004). Nonaka's (1991) problematic features of the SECI model are its very strengths: its simplicity. Making tacit knowledge readily available to managers who have no time to read on epistemology is what paved the way for Nonaka and his colleagues to seduce the world of management and management sciences (Ray 2009). The illusion of a static externalised state of knowledge has confined knowledge management practices into a bounded functionalist focus on a noble quest to discover and extract knowledge from the jaws of the outside world. Consequently, Polanyi's (1958) 'we know more than we can tell' becomes a handicap;

knowing more than we can tell suggests that we can never fully communicate what we mean across to the outside world. It is due to this 'impediment' that all studies seem to engage with issues of epistemology in the search for ways that enable the transfer of meaning across to the external world.

It is worth noting that Polanyi's (1946; 1958; 1969) writings were intended to study the operation and impact of science on society, an early branch of the principles of Science and Technology Studies (STS). Nonaka's (1991) interpretation of Polanyi's work seems to have filtered all that is in favour of an epistemologically unsettling version of tacit knowledge, and with it, the birth of knowledge management. Yet there is a striking resemblance between the STS and knowledge management studies. STS is the study of how society organises scientific knowledge and how, in turn, scientific knowledge organises society (Hackett et al. 2008). STS includes the study of hybrid methods very similar to knowledge management's process of acquisition (in STS it is scientific inquiry), codification (STS is concerned with rhetoric) and transfer (STS extensively discusses different theories of interactionism), just to name a few of the comparable concepts and themes (Sismondo 2010). Polanyi himself has written a marvelous piece on the economics and politics of 'The Republic of Science' (Polanyi 2000). A simple inspection of this script will demonstrate the colossal potential it has to contribute to knowledge management. Another similar philosophical study of the impact of knowledge and its order is in the sociology of knowledge (later sociology of scientific knowledge or SSK). Berger & Luckmann's (1966) study on the sociology of knowledge contains remarkable arguments and ideas that are of profound importance to knowledge management. It's as though investigating beyond Nonaka's (1991) reinterpretation of Polanyi's (1958) tacit dimension is too far a journey for the liking and comfort of the knowledge management community. Even when being critical of the philosophical basis of Nonaka's (1994) work, scholars do not look beyond the tautology of knowledge forms. It is so often that either alternative tacit/explicit interpretations are suggested or completely new distinctions of forms are proposed (Tell 2004).

One of the major issues arising when categorising knowledge into end-state entative forms is that it lends itself to the notion of externalisation. What is really meant by externalisation? It is usually implied as referring to the detaching of explicit knowledge from its tacit roots, or as a technique to explicate an inexplicable tacit in others. To better understand the complexity involved, one can take Williams' (2006) interpretation of data and information. Although his study is rather similar to much of the somewhat unpersuasive research in knowledge management that attempts to commodify knowledge, his method of investigation sheds light on the misleading concept of absolute accuracy of information and data. Williams (2006) commences his argument by rejecting the notion of tacit/explicit knowledge and instead introduces another trichotomy of 'formal', 'procedural' and 'contextual' information. He claims that by strategically aligning these information types, the competitive advantage of knowledge management is realised. 'Formal', 'procedural' and 'contextual' information processing is based on a semiotic transformation approach, which is where his argument becomes more interesting. Semiotics (the study of symbols and their meanings) reveal two types of processes that are meant to transform a semiotic meaning into a meta-semiotic one (an abstracted, objectified and formalised form of a semiotic meaning). These two processes are subject-stripping and context-stripping. Subject stripping is the process by which knowledge is structured in a form that can be understood and used by anyone. The root subjective rationality of the agent of a particular knowledge is apparently stripped away. Context stripping is the process by which knowledge is structured in a form such that it can be implemented anywhere, anytime, and with the same results. The root context from which the knowledge originated is stripped away so that it becomes more susceptible to other contexts. Context and subject stripping of information is presented as a substitute and more realistic process to the externalisation process of a magical tacit dimension. Yet later on in his paper, Williams (2006) tends to imply that completely stripping information of its subject and context of its original conception is not possible. He attempts to avoid his contradictory statements by stating that his investigation is less than ambitious about philosophical discussions. The criticism here is not meant to undermine the merit of the doctrine of facts; on the contrary, objectivity is a vital constituent of management science (or any scientific field). Reducing knowledge of projects into facts of pure presence as information or data is justifiable to information management and information system, not knowledge management. Limitations of facticity should always be addressed in the science of knowledge management.

Another major problem with categorising knowledge into end-state entative forms is the ease with which it permits information to be interchangeable with explicit knowledge. Ray & Clegg (2007, pg. 22) ask "What is the advantage of talking about 'explicit knowledge' if we mean 'information'? Or, put another way, how does the use of 'explicit knowledge' denote something that is different from 'information'? What is the justification for the epithet 'knowledge'?" Like the previous complications, this misunderstanding seems to point directly to the assumption that knowledge is an entity we come across face-to-face. It would seem that data, information, and knowledge undergo a series of analyses, aggregations, and syntheses to be transformed back and forth. The series of steps are assumed to be successive and linear in matters of validity and proof (Faucher, Everett, & Lawson 2008). Complications arise when one realises that in reality, reason alone does not promote a consensus on meanings. What constitutes knowledge is by no means a smooth linear process of justification, rather a spiral of bifurcations, ruptures, crises, and digressions of unanticipated passages meant to attain an unproblematic consensus of meanings (Styhre 2003). More critically so, the absoluteness of facticity that ‘data’ and ‘information’ exhibit is a delusion. Suppressed here are discussions of power relations of those who actually determine the meanings behind facts. Neither rationality nor reality can provide the ultimate warrant (Spender & Scherer 2007). In the words of Heinz von Foerster: ‘objectivity is the delusion that observations could be made without an observer’ (Glasersfeld 2007).

The entative view of knowledge and its transformational management strategies is a simple and comprehensible epistemological paradigm, easily understood and exercised by the busy manager (Ray 2009). Nonetheless, theoretically it is overwhelmed by the problem of the independent existence of knowledge, and practically it misses the reality of knowledge re-creation and semantic shifts in seemingly steady knowledge management processes such as codification, storage, and integration. So for example, at face value, knowledge codification is taken as the collection, compression, and storage of knowledge. However, collection, compression, and storage of knowledge include various approaches of knowing; such as researching, validating, data entry, and data extraction. Similarly, knowledge retrieval is not just a mechanical search and find effort; it involves intuition, sense-making, and awareness of the easier faster path (Dalkir 2011). Knowledge retrieval requires that information be chosen, distilled, and focused to address the issue at hand. Similarly, knowledge sharing is not just a learning mechanism for the listener and reader, but also for the speaker and the writer. Entative knowledge could be successful to implement as an amalgamation of information management and knowledge management, which is more than what regular small business enterprises need. But a full-scale project knowledge management theory, needs a full scale knowledge philosophy.

2.3 Alternative Knowledge Management Philosophy: Evolution of Intelligence

Intelligence, not Knowledge

If the entative knowledge paradigm is self-contradictory and confused and the processual knowledge paradigm is similarly perplexing and confusing, it is discouraging to adopt either of them into an epistemological frame for project knowledge management. So what other knowledge philosophy could be selected? And on what basis? The different tacit dimension philosophies of knowledge share one thing in common; a firm assertion that knowledge and knowing is possible only to the individual or (in some misinterpretation) the collective mind. This theoretical perspective makes a noteworthy opening statement to consider as a starting point for developing an alternative philosophy of knowledge. Usually theories of knowledge that allow knowing to exist as an ability independent of the knower are seldom convincing. Most epistemologists would agree that knowledge and knowing as activities have to have a mind in both a biological and cognitive sense. Hence for knowledge to exist outside the individual, '*mind*' gets redefined differently.

There are three basic mind theses; monastic, dualistic, and extended mind. Usually all the different monastic and dualistic theories of mind contend that knowledge is brought about by the individual or the collective mind; notable examples include Polanyi's (2009) tacit dimension, Bergson's (1998) intuition/intellect thought processes, Wittgenstein's (2010) language games, and Bakhtin's (1981) sociolinguistics. Knowledge theories related to the extension of mind contend that knowledge is brought about by the interaction of the subject with the object where the mind is in the interaction of things; notable examples include Latour's (2007) translation, Clark & Chalmers' (1998) active externalism, and Zhang & Norman's (1994) distributed cognition. In completely all of these examples, knowledge has not exactly left the knower. It still exists within a community of knowers or their vicinity of interaction under the justification of the existence of ‘mind’. We beat around the bush only to come back facing the same tenacious problem: how can knowledge exist independent of the knower? This age old question, stunningly, could be solved by substituting *knowledge* with *intelligence* rather than *mind*.

There is no one formal definition of intelligence. It has been defined accordingly to explain different fields of study such as psychology, philosophy, cognitive science, neurology, and education. A public statement released by the Wall Street Journal in 1994 produced 25 conclusions deduced from 52 scholars studying intelligence from separate academic fields in an attempt to reach a common definition. The statement was later published in Gottfredson (1997) under the same title: *Mainstream Science on Intelligence.* Yet it has been criticized by many including one of the signatories of the statement, Carroll (1997), who argued that he could not find an explicitly shared agreement between the 25 conclusions. Other studies such as Schlinger (2003) and Alderfer (2003) remind us that the statement was originally meant to discredit Richard & Charles (1994) rather than establish an academic consensus on the meaning of intelligence. The definition of intelligence that this doctoral thesis will follow therefore is one that is primarily relevant to knowledge management studies; where intelligence means the *natural or mechanical* cognitive ability to accumulate, share, and manipulate knowledge. This implies that intelligence involves a capacity of memory and recollection (Gottfredson 1998), different information processing facilities for various thinking approaches (Carroll 1997), and an aptitude for problem-solving (Gardner 2011) and learning from experience (Gottfredson 1997).

The concept of intelligence will be also interpreted based on Sagan’s (1977) Pulitzer Prize winning *The Dragons of Eden: Speculations on the Evolution of Human Intelligence*, which observes how intelligence first migrated from genes to brains and eventually outside natural bodies by using the still controversial theory of evolution published by Charles Darwin in 1859. The beauty of the idea is in the *ease* and almost *effortlessness* with which it dissolves the complex epistemology of independently existing knowledge. It turns out that by espousing natural science (rather than philosophy) with knowledge management, it is not only easy to see how knowledge and knowing can exist independent of the knower, but also how external intelligence can be superior to that of a biological one. This is highly practical in terms of knowledge management terms when interpreting how knowledge storage capacity (a kind of intelligence) in computer servers is larger and longer lasting than that of a natural one. Sagan's (1977) speculations even closes with a prophecy of the future where external mechanical intelligence will be used to enhance biological ones; a stunning prediction slowly being realized in the world today (Harari 2014; Harari 2017). The following sections will make a quick journey through Sagan's (1977) work and absorb its ideas and lessons for the field of knowledge management.

The Evolution of Intelligence

In the beginning, a cosmic event of theological proportions called the 'big bang' literally exploded reality into existence. Scientists believe that it brought with it matter and energy as we know them, and occurred some 13.7 billion years ago. It was only 4.6 billion years ago that the earth was gravitationally moulded from the debris of a stellar explosion, slowly terraforming into conditions suitable for life to begin. By accident of an exact combination of certain molecules (today studied as organic) and under the right circumstances of temperature, pressure, moisture, and light some 3.8 billion years ago, the first cell was created (Sagan 1977). These single-celled organisms contained all signs of life encoded in hereditary helix shaped biochemical units called the DNA (Deoxyribonucleic acid). In the early years, the information coded necessary for life was simple and small; a conclusion drawn based on the little number of functions organisms exhibit. As time passed, only those cells with the DNA learning more life tricks could survive to multiply, slowly amassing more information and developing a more complex coding system that puts more data in less molecular space (Sagan 1977). This was a time for *genetic intelligence* to first grow and flourish among the million or so different varieties of unicellular organisms. It took almost three billion years for unicellular organisms to evolve into highly intricate and compound multicellular ones, and a couple of million more for the terrestrial plants and animals to emerge out of water. During this time, the intelligence of the DNA could not evolve any faster to account for the violently changing conditions of survival of beings billions of times bigger than a single cell. Therefore, a new organ slowly started to appear, one that can respond to immediate ecological effects not encoded in the genes – the brain.

The power of the brain of early reptiles, birds, mammals, and fishes was speed; speed of learning and speed of reacting to new knowledge. The weakness of the brain is that it could not retain information from ancestors by birth; the brain has to learn by experience rather than inheritance. Thus, as the brain evolved in complexity and intricacy, a new kind of information started to appear among the creatures of the earth: socio-cultural rather than genetic. The human species first began appearing when the genus *Homo* evolved from the great apes some 2.5 million years ago. The three well recognized human species amongst evolutionary biologists Homo habilis, Homo erectus, and the Neanderthals, exhibited a spectacular feat of brain intelligence (*extra-genetic intelligence)* by using tools in a complex manner. The later appearing Homo sapiens (appropriately Greek for *man the wise*), exhibited an even more remarkable feat of using tools in a way no other human species ever had during the 10,000 BC agricultural revolution. The agricultural revolution brought with it an explosive rate of community growth and slowly people began shedding their natural hunter gatherer instincts and living together for trading food and other items among their different communities. In time, the first civilizations appeared in Mesopotamia around 4500 BC. It was then that a new kind of intelligence first appeared – *extra-somatic intelligence* – and for the very same reasons extra-genetic intelligence first appeared: one man could not have handled all the rapidly shifting bulky information of economic transactions that took places in the 3000 BC Sumer civilization, neither would the citizen of Sumer have placed their trust in the word of an assembly of men. The invention of writing was a miracle; intelligence has been for the first time externalised outside the body by engraving linguistic statements called *cuneiform* on animal skin and stones (not considering proto-writing which is the earlier mnemonic symbolic engravings on caves that conveys information but are devoid of linguistic context). Thus, the first kind of extra-somatic intelligence was of recollection capacity. The first empire that came after Sumer – the Akkadian empire – advanced the information storage capacity of cuneiform into a processing capacity; a simple system of mathematical calculations. Much later during the Han dynasty the Chinese invented printing, effectively advancing the information sharing ability of extra-somatic intelligence. Four decades ago Sagan (1980, pg. 223) wrote “The great libraries of the world contain millions of volumes, the equivalent of about 10^{14} bits of information in words, and perhaps 10^{15} bits in pictures. This is ten thousand times more information than in our genes, and about ten times more than in our brains.”

Extra-somatic intelligence entered a new age of advancement when in the 1940s the computer was invented. Extra-somatic intelligence in early 1980s computers may not be fully autonomous but certainly has the superior ability of information organisation, speed of processing, and storage capacity than extra-genetic intelligence. Today, post new millennia, we are on the verge of artificial intelligence and with it the last step of evolution of extra-somatic intelligence. Brown, Duguid and Weinberger (2017) describe the ‘autonomous agent’; a technological artifact that carries out information manipulation with an increasing degree of autonomy and independence from its user. Similarly, Cook (2010) offers a different approach to assessing the capabilities of the technological artefacts in comparison with that of biological humans because, he argues, the classical Turing vs Searle debate is no longer relevant given the recent breakthroughs in artificial intelligence. The kind of information processing that we are familiar with (either algorithmic or heuristic) is being replaced by far more exhilarating 'cognitive' capabilities, such as deep learning (Goodfellow, Bengio, & Courville 2016), knowledge representation and reasoning (Russell & Norvig 2010), and computational creativity (Pereira 2007); all of which are offering preliminary experimental evidence that machines can create meaningful knowledge. The mission of the scientific and technological communities that study intelligence have even widened their focus from *simulating* natural intelligence to *enhancing* it. Sagan (1977, p. 216) writes "Perhaps someday it will be possible to add a variety of cognitive and intellectual prosthetic devices to the brain – a kind of eye glasses for the mind. This would be in the spirit of the past accretionary evolution of the brain and is probably far more feasible than attempting to restructure the existing brain". Similarly in a stunning chapter about 'intellectual prosthetic devices' to the brain, Harari (2014) describes a research endeavour that is investigating the possibility of implementing wirelessly connected chips that can read electric mind waves and transfer them across the World Wide Web. Individuals will literally be able to read each other's minds. What would project knowledge management look like then? The social, economic, and technological implications of such a bionic chip are impossible to predict considering that it will introduce the human mind into a level of consciousness previously unknown. One can only speculate on what these developments mean for natural and mechanical life in the future.

A New Philosophy for a New Discipline of Project Knowledge Management

The stunning insight of Sagan's (1977) analysis of evolution of intelligence from genetic to extra-genetic to extra-somatic is the cornerstone theory this doctoral thesis adopts to build a project knowledge management philosophy. As clarified earlier, the different forms of abilities that intelligence amassed over 3.5 billion years as it split between different species and shifted from inherited to learned to externalised cannot be simply summarised into one definition. For a primarily relevant project knowledge management knowledge philosophy, intelligence is defined as the different natural or mechanical dexterities to process knowledge; where process could mean anything from retention, to dissemination, to creation. For instance, knowledge storage, accumulation, circulation, and formulation are all different kinds of intelligences. For simplicity and applicability, the terms *extra-genetic* and *extra-somatic* are substituted with *natural* and *mechanical* respectively, where natural intelligence refer to intelligence that is part of the knower and mechanical intelligence refer to intelligence that can exist independent of the knower. As for the scientific and technological advancements of today, mechanical intelligence still needs some form of input from natural intelligence to run. However, it is predicted that in the not so distant future, mechanical intelligence would be completely autonomous and able without any need for intervention from natural intelligence (Callaghan et al. 2017; Harari 2017).

There are cognitive areas where mechanical intelligence is superior to natural intelligence and vice-versa. For instance, a mechanical intelligence as simple as a paper and a pen can store knowledge more efficiently in terms of speed and flawlessness in recollection than a complex natural intelligence can. Likewise, the mechanical intelligence of packet switching network platforms transcend time and space more than natural intelligence ever could. Mechanical intelligence can last centuries longer, absorb information a thousand times faster (think of memorizing a 1000 page book vs saving it on a USB), and transfer knowledge to the other side of the planet as fast as the speed of light. Mechanical intelligence also has an information processing speed hundreds of times faster than that of a natural one. Nonetheless, where knowledge creation and comprehension is concerned, natural intelligence holds the superior position. The human mind has a spectacular capacity for absorbing knowledge simultaneously through several thought processes that mechanical intelligence doesn't have (Sagan 1977). It can accept and process massive aggregates of contradictory knowledge, where mechanical intelligence immediately returns 'error' for the simplest contradiction (Harari 2014). The intuitive estimation of the subsidiary awareness is amazingly steady and accurate; an auto-drive cognitive capacity that can process several inputs simultaneously without effecting focal awareness (Polanyi 1969). Natural intelligence can imagine, create, experience, and converse better than any cutting edge artificial intelligence machinery can.

Given their distinctive and different intelligence abilities, one can certainly appreciate the potential for mechanical and natural intelligence to complement each other rather than simply contrast them, especially since mechanical intelligence is yet to become independent. This is a particularly important conclusion to reflect upon when considering the philosophical applications that Sagan's (1977) speculations will have on a proposed project knowledge management discipline: where Polanyi's (1958) tacit knowing necessitates a *transformation* process to *convert* from one form of knowledge to the other, Sagan's (1977) evolution of intelligence necessitates a *utilisation* of one kind to intelligence to *enhance* the other. Sagan's (1977) 'evolution of intelligence' is both stable and complex free, which is the best of both of what the entative tacit and processual tacit can offer minus the confusion they come with. This powerful philosophical basis is the exact locus where organisational knowledge management is disentangled from project knowledge management.

Now that this insight has successfully decoupled organisational knowledge management philosophy from project knowledge management philosophy, the following section will concentrate on the theoretical decoupling of project knowledge management from organisational knowledge management.

2.4 Knowledge Management Theory: Projects & Organisations

A Project or an Organisation?

As mentioned earlier, the philosophical foundations of Nonaka's (1991) *Knowledge-Creating Company* are not the only fundamentals that made their way into project knowledge management publications. Theoretically, what makes project knowledge management unique to project management is not a topic readily found in literature. Those few studies and debates that address this issue are somewhat vague as to where exactly project knowledge management and organisational knowledge management become separated. For instance in a guest editorial of a special issue of the *International Journal of Managing Projects in Business* that addresses knowledge creation in projects and project-based organisations, Canonico et al. (2013) acknowledges that Nonaka & colleagues' study of knowledge management is based an organisational context, yet later notes that many of the empirical examples given by Nonaka and colleagues actually come from a project context. The entanglement between project knowledge management and organisational knowledge management can be also observable in research work addressing project-based learning and organisational learning. In an interesting exploratory study by Scarbrough et al. (2004), project-based learning processes are proposed to be a subservient sub-level to organisational learning, as the two blend by means of knowledge absorption practices. Organisational knowledge management has gone so deep into project management that it is nearly impossible to find a project knowledge management study that openly distances itself from organisational knowledge management.

The depth of this entanglement is actually observed all the way down to the very identity of projects and project management. Monikers such as ‘temporary-based organisations’, ‘project organising’, ‘project as organisational-form’, and ‘pluralistic project management’ occupy highly cited and academically inclined journal articles in project management literature (Bredillet, Tywoniak & Dwivedula 2015; Winch 2014; Söderlund & Sylvain 2013) and produce unusual approaches to practical strategies and techniques of project management such as Bredillet’s (2010; 2008) meta-approach to project management processes. Ika & Bredillet (2016) and Ahern, Leavy & Byrne (2014) are some of the few studies that recognise this matter; nonetheless, readily assuming no weaknesses related to project-organisation hybridisation, only opportunities. In fact, this is as close as one can get to criticisms of a kind of project management that is soaked within an organisational ontology. The literature on the project-organisation and the organisation-project covers a myriad of topics and subjects, and only grows bigger, wider, and more diverse with every study (Söderlund 2013). If one were to do a test of how far along it has progressed today, they can simply type ‘difference between project and organisation’ in an academic library; the search request is guaranteed to yield the very opposite results! Morris, Patel, & Wearne (2000, pg. 156) eloquently summarise the thin line that separates managing projects from managing organisations: “Put simply, is it to deliver ‘on time, in budget, to scope,’ or is it to deliver projects successfully to the requirements of the project customer/sponsor?......What managers in government, business, academia—just about everywhere in fact—are concerned about is that their projects are managed effectively and efficiently; that they represent value-for-money and meet or exceed their strategic objectives”. Projects with blurred objective sets, implicit expectations, stakeholders’ mood sways, and unforeseen budget and time overruns are not new or unusual challenges to project management. What is unusual about the project-organisation is to *expect and accept* these issues, and not in a risk management mode of interaction, but rather in a premeditated welcoming attitude to continuous expansion of project constraints.

Back in the early 2000s, Turner & Müller (2003) suggested that the introduction of an organisational identity to projects and project management was not to correct a wrong, but rather to fill in the blanks of a definition gravely needed to compensate for the massive projectising enterprise that captured almost all types of economic and business institutions and operations. Projectising does not merely transmute organisational ontology, it also alter their constituent management functions and strategies such as operations, finance, and human resources (Mir & Pinnington 2014; Huemann, Keegan, & Turner 2007). Intellectuals who are committed to furthering this agenda build their case by presenting arguments based on the empirically demonstrated advantages of project-organisations hybrids and contrast them with the more traditional project management theories and practices that are promoted by project management professional bodies such as the PMI. They are skeptical of the paradigm that shapes it, mostly with the impression that it is still dominated by the closed system reductionist approach adopted from the field of engineering and scientific methods some seventy years earlier (Pollack 2007). Criticism is leveled at the 'unchecked' and 'obsolete' fundamentals of project management and the consequent force that funnels the focus of project management strategies into mechanical reductionism and away from organic holism. The limitations of instrumental rationality that governs the field, Cicmil & Hodgson (2006) argue, are such that given all their sophisticated advancement in modelling that accentuate planning and control, they neither eliminate project failures nor guarantee project success.

A particularly distinctive worldwide recognition and legitimacy of this approach to project management began around 2003 when the Engineering and Physical Sciences Research Council of the UK agreed to fund a massive research network of what they titled, ‘Rethinking Project Management’. This venture was led by high profile management scholars such as Winter et al. (2006) and Winter et. al. (2006) and continues to prosper (Ika & Söderlund 2016). During the time period between the early like-minded ‘Scandinavian turn’ (Kreiner 1995; Lundin & Söderholm 1995; Midler 1995; Packendorff 1995) and ‘Rethinking Project Management’, the movement was slowly but clearly gathering momentum by publishing their ideology of temporary organisations in diverse management books and journals such as Söderlund (2000), Fournier & Grey (2000), Hodgson (2002), Sahlin-Andersson & Söderholm (2002), and Engwall (2003). Post 2006, the ‘rethinking project management’ movement fueled two more similar schools of thought – Making Projects Critical and the Scandinavian School of Project Management (Walker & Lloyd-Walker 2016). Today, these approaches to project management are being championed by management scholars and intellectuals directly (such as Brookes et. al. 2017 and Turner, Kutsch, & Leybourne 2016) or indirectly (such as Padalkar & Gopinath 2016 and Gustavsson & Hallin 2014); and as polity coordinated (such as Svejvig & Grex 2016 and Jacobsson, Lundin & Söderholm 2016) or individual efforts (such as Marshall & Brensen 2013 and Pinto & Winch 2016). The proliferation of the project-organisation and the organisation-project in the past twenty years or so brings to mind Whitty’s (2005) fascinating study on project management memetics; the idea of project management as a conscious selfish societal gene (meme) that evolves for the sole purpose of multiplying and existing forever, regardless of the benefits or harm it brings to its human hosts.

The conceptual fluidity hosted by the project-organisation is eroding the unique characteristics and meaning of the words ‘project’ and ‘project management’ mainly by assuming highly partial, flexible projects with porous boundaries making it brittle and fragile – perhaps to the point where one project becomes a completely different project (Lenfle & Loch 2010). This has more possible consequences than immediately meets the eye. For example, for Shenhar & Dvir (2007), the project goal is not completion within scope, budget, and time, but the achievement of multiple results surrounding multiple criteria more numerous than was originally planned. Accordingly, the main focus of project management is the value creation (deliberate and unintended alike) to another organisation, typically to that from which it formed (Andersen 2008). The phasing of projects (with specified life cycle and constraints) into a temporary organisation (with open life cycle and constraints) and back whenever contextually or situationally necessary, seems to be the perfect solution to account for all of the integrations of multiple management fields with project management. At what point can we consider the changing objectives no longer part of the same project? Projects as temporary organisations tells us at no point; so long as objectives are being updated, reorganised, or changed, are they still under the umbrella of the same project. More interestingly, there are no rules and regulations for when to decide that a project is no longer needed for the emerging objectives. The responsibility of the project to handle the objectives can be slowly transferred to the benefactors before official delivery. The flexibility of projects to phase in and out instead of official opening and closing procedures is indeed a clever and elegant solution for both academics and practitioners; nonetheless it comes at a price; it breaks down specific project identity standardisation laws and practices.

For a project knowledge management theory that is idiosyncratic to project management identity and characteristics, it is important to review knowledge management theory within a classically defined project context rather than one that sits within an organisational ontology. PMI's (2013) *A Guide to Project Management Body of Knowledge* is the best book to do so given its often criticised dedicated stubbornness to preserve the originality and uniqueness of projects and project management. PMI (2013, p. 2) defines a project as “a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates that a project has a definite beginning and end.” Project management is defined as “the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Project management is accomplished through the appropriate application and integration of the logically grouped project management processes, which are categorized into five Process Groups. These five Process Groups are: Initiating, Planning, Executing, Monitoring and Controlling, and Closing.” (PMI 2013, p. 4). A key distinction of project management is “(b)Balancing the competing project constraints, which include, but are not limited to: Scope, Quality, Schedule, Budget, Resources, and Risks” (PMI 2013, p. 5). The next section will deeply investigate these characterisations and propose a theory of knowledge management that differentiates projects from organisations.

Deconstructing Organisational Knowledge Management from Project Knowledge Management

With all its rewards, projects-as-temporary-organisations presents a major problem for this thesis; how then does the knowledge management discipline establish practices for managing knowledge of projects that are distinctive from managing knowledge of organisations? To complicate things even more, knowledge management is itself an organisational study in its roots, strongly influenced by Nonaka & Takeuchi’s (1995) ‘The Knowledge-Creating Company’ and inspired to engage in further organisational reforming. The entanglement of knowledge management and organisational management since then have only grown deeper and matter-of-factly. A systematic review concerned with the role of artifacts in knowledge management literature conducted by

Mariano & Awazu (2016) found out that majority of the journal articles focused at an organisational level of analysis. To appreciate the extent by which organisational management has shaped current knowledge management all one has to do is read almost any book on an all-purpose ideas of knowledge management (for example Becerra-Fernandez & Sabherwal (2015), Hislop (2013), or Dalkir (2011)). The subject matters are essentially the same: information management vs knowledge management; Nonaka, Wiig, Drucker, and Von Krogh; organisational learning; social nature of knowledge management; and the role of technology and social media in knowledge sharing and storage. Organisational knowledge management was absorbed somewhat uncritically by project management scholars. The organisational knowledge management signature rhetoric and monikers are unmistakable in most project knowledge management studies. It is important to deconstruct the organisational backbone of knowledge management along with the notion of the project-as-temporary-organisation if there is to be any hope of outlining an exclusive theory of project knowledge management.

The work measures of organisations can be described as an ongoing effort generally characterised by the repetitiveness of existing procedures (Anderson 2016). The growth of organisations out of current activity systems and set boundaries and their expansion into new markets and new product lines is a major area of organisational management studies called 'Organisational Development' (OD for short). The typical subject matters of OD include change management, organisational learning, transitions and transformations, and even leadership typologies and strategies (Alsop & Smith 2016; Burke & Noumair 2015; Garden 2015). Studies that investigate OD are often weary of rigidity, normativity, and complacency in the organisational environment, culture, structure, and control-driven principles. They encourage an induced instability and a leap of faith to grow into new markets and industries (Purser & Petranker 2005; Wang & Ahmed 2003; Morrison & Milliken

2000). Thus, in an overall depiction of organisation, one can argue that for most of their lifetime they are stable, steady, and certain with interruptions happening every now and then encouraging them to expand and develop *outwards*. This is clearly reflected in Nonaka's (1991) paper and later book Nonaka & Takeuchi's (1995) knowledge creation spiral within the SECI model. The knowledge creation spiral "becomes larger in scale as it moves up the ontological levels. Knowledge created through the SECI process can trigger a new spiral of knowledge creation, expanding horizontally and vertically as it moves through communities of interactions that transcend sectional, departmental, divisional, and even organisational boundaries" (Nonaka & Toyama 2003, p. 6). The intrinsic philosophy of outward knowledge growth and flow is essential for any organisational knowledge management model or theory due to organisations' typically stable life time. Knowledge management essentially *induces controlled instability and volatility* through crafting and implementing new ideas and alternative options (Magala 2017). In contrast, a typical project's lifetime is characterised by the turmoil of uncertainties and differences the project creates as it emerges (Canonico et. al. 2013; PMI 2013). Stability breaks out every now and then, and tends to become more frequent and enduring as the project materializes (Ramasesh & Browning 2014). To account for its mostly unstable life time, it is essential for project knowledge management to *induce stability* by enhancing and developing process plans, procedures, and implementation methods; in other words, knowledge management in projects has an intrinsic philosophy of *inwards* knowledge growth and flow. Unlike organisations, a project's success is in its ability to meet fluctuating constraints, not outgrow steady ones. The difference between meeting constraints and outgrowing them in terms of knowledge management is best described as an unbalanced ambidexterity of knowledge creation between exploitation and exploration.

Like all knowledge theories, the reasoning and rationale behind knowledge exploitation and knowledge exploration remains a contested one. The generally accepted distinction is that where knowledge exploitation are activities related to refining existing solutions, knowledge exploration are activities related to developing radically new ones (March 1991). Both exploitation and exploration involve the formation of new knowledge; the difference is in the means and ends of exercising each type of knowledge creation (Gupta, Smith, & Shalley 2006). Knowledge exploitation excites learning by engaging with established knowledge assets with the intention of development and optimization of existing processes, systems, practices, policies, plans, or implementation procedures (Hatch & Cunliffe 2013). Knowledge exploitation by definition requires that previously established knowledge assets guide the process of learning and transformation (Laureiro-Martínez et al. 2015). For example, a project implemented with the aim of enhancing the efficiency of a production line of a car's engine must first necessarily understand the current Six Sigma control chart and the technical assembly of machineries. Knowledge exploration, in contrast, excites learning by establishing a whole new trajectory previously unfamiliar to the institution, with the intention of outgrowing the organisation's boundaries into new areas of production and business (Hatch & Cunliffe 2013). Knowledge exploration requires the engagement of selective attention to alternatives rather than a previously established knowledge base (Laureiro-Martínez et al. 2015). For example, an organisation might decide to expand its hygienic manufacturing products of hair shampoos and body lotions to include sanitary products. For the chemists working on developing a new formula, it is not necessary for them to know the chemical makeup of shampoos to create a bathroom bleaching agent. Instead, they would turn to experimenting with different cleaning formulas using a variety of methods. Exploration and exploitation processes have been shown to be innovative (Benner & Tushman 2003), transformative (Mom, Van Den Bosch & Volberda 2007), and experimental (Gupta, Smith, & Shalley 2006). Given their definition it is easy to fall into the mistake of assuming that exploitation is learning from internal sources while exploration is learning from external sources. This is a false account of their differences because each can be practiced in either way. The distinction between them is essentially in the outcome (an enhanced efficiency and improved product vs. a new system and a new market) and the process (established knowledge guide vs. selective attention to alternatives) by which it is achieved.

Turner, Maylor & Swart (2014) and Eriksson (2013) are of the opinion that project management should run an ambidextrous balance between exploitation and exploration; as are the organisation management scholars, Birkinshaw & Gupta (2013) and O'Reilly & Tushman (2013). The idea of ambidexterity has taken hold in management studies only recently (Turner, Maylor & Swart 2014). It reflects the project-organisation and the organisation-project modes of learning in projects and organisations. As previously discussed, these organisational ontology of project modes of thinking need to be discarded in order to achieve a definitive theory of project knowledge management. In an ideal world where organisations and projects are two different institutions, it is easy to discern the dominant knowing mechanism based on their life time and ultimate purpose. An organisation's ultimate purpose is to grow beyond its constraints over a long-term period of existence and to engulf new markets and industries. Growing beyond constraints essentially requires that innovative exploration overtakes innovative exploitation in an organisational work context; that is what organisational knowledge management models and theories strive for, and that is fundamentally the mission of *The Knowledge-Creating Company* and its descendants. In contrast, a project's ultimate purpose is to efficiently and effectively meet its defined constraints, just in time before its temporal life comes to an end. Efficiently meeting defined constraints requires that innovative exploitation overtakes innovative exploration; in other words, as per the classical interpretation of project management, *evolving* pre-established knowledge is more dominant than *creating* radically new knowledge. That is what project knowledge management theories and models should strive for, and that is fundamentally the mission of the proposed 'Knowledge-Evolving Project'. The knowledge creation spiral of *The Knowledge-Creating Company* is appropriately directed outwards; an indication of exploring new markets and industries as new knowledge is being shaped and implemented through the levels of an otherwise stable organisation. The 'knowledge evolving spiral' of the knowledge-evolving project on the other hand, is applicably directed *inwards*; an indication of growing *into* the project as it emerges through its finite life cycle by enhancing processes and procedures of implementation of previously established plans and objectives. The knowledge-creating company stimulates learning by inducing instability, whereas the knowledge-evolving project stimulates learning by inducing stability. Interestingly, projects running in organisations is one of the ways to motivate organisational learning and development by inducing controlled instability and a manageable degree of flux for the purpose of implementing new ideas (Duffield & Whitty 2016; Leybourne & Kennedy 2015; Crawford & Nahmias 2010; Scarbrough et al. 2004).

There is an idealistic fit between knowledge exploitation and the project life-cycle. It is fairly straightforward to imagine the knowledge evolving spiral mounting within the project life cycle. Each project phase is theoretically translated to the effects it will have on project knowledge management; project initiation and planning requires that all project knowledge be defined at the outset, project implementation requires that predefined knowledge guide the creation of new knowledge, project monitoring and control requires that new knowledge be assimilated by unlearning inadequate knowledge and integrating it with prevailing knowledge, and project closure requires the availability of the fully evolved knowledge that completed the project:

1. During initiation and planning processes, all knowledge *essential* for project completion is formed, decided on, and authorized. This knowledge is recorded in managerial process-based documents such as the work breakdown structure, communication matrix, and risk management register; and technical-based or product-based documents such as material requirements, machinery use manuals, safety instructions, and experimentation procedures.

2. During implementation, the established knowledge formulated at the outset (initiation and planning) is what is used to execute the project. When problems and difficulties arise, they are often overcome by developing and building on the established plans and policies rather than generating fundamentally different information. In other words, established knowledge predominantly directs and guides new knowledge creation.

3. During monitoring and control and planning, newly created knowledge is assimilated into the pre-existing knowledge by simultaneously unlearning inadequate knowledge and integrating it with prevailing knowledge

4. At closing, all knowledge and lessons learnt from a project are only fully elucidated and completed at the end of the project life-cycle, when the project has fully emerged. This knowledge can be stored and used later for other projects.

The fit between the project’s life cycle and knowledge exploitation is idealistic because in reality the life cycle of a project runs through overlapping interactions of initiation, planning, execution, monitoring and control, and closure, with the dominance of named processes respectively at each stage (see Figure 2.1 on the next page). Further to these overlapping processes, there are multitudes of variations in interpreting the standard five processes and life-cycle of projects in terms of function, flow, and interaction, in practice as well as in theory (see for example Kloppenborg, Tesch & Manolis (2014), Eadie et. al. (2013), and Aaltonen & Kujala (2010)). Nonetheless, it is important to examine the knowledge exploitation effect in projects from an idealistic perspective to be able to recognise and identify them. In project realities, these knowledge effects transpire in no particularly strict order within the project life-cycle, and are the composition of the inward growing knowledge evolution spiral.

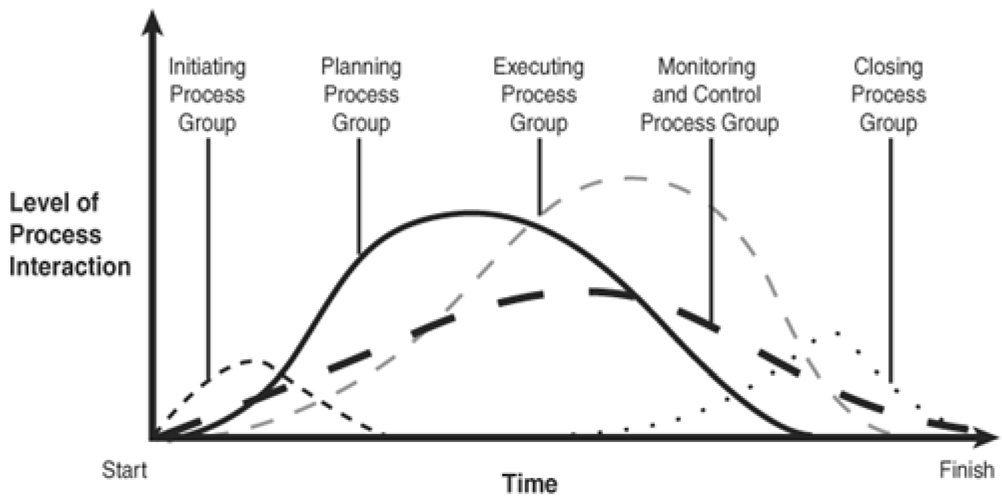

Figure 2.1: Project Management Process Groups Interaction (from PMI 2013, pg.51)

There are three important misconceptions to be aware of when investigating the knowledge-evolving project. Firstly, knowledge evolution does not imply that external knowledge sources are not explored, rather, that all relevant knowledge sources, external or internal, are primarily guided by a predefined knowledge base with the objective of evolving it. Knowledge creation by using knowledge sources external to the project can and does occur (Gasik 2011). Clearly, channeling external knowledge sources by cross-project learning is often said to be a characteristic feature of project management (Hartmann & Dorée 2014). Secondly, knowledge evolution should not be confused with the concepts of knowledge assimilation, knowledge integration, and knowledge absorption; these are all separate processes or sub-processes meant to build on previous knowledge and then make it common throughout the organisation. Knowledge evolution is more effectively understood as a complete cycle and not a single process. It necessitates the dominant engagement of previous knowledge to evolve continuously until the completion of the project. Thirdly, the knowledge evolving spiral flowing inwards does not imply a purely knowledge exploitative effort. Knowledge exploration occurs all of the time during its life cycle. What the inward evolving spiral depicts is knowledge exploitation purposefully overtaking knowledge exploration to meet constraints efficiently rather than grow outside of them.

There is one more feature the project life cycle reveals about its unique and odd facility of knowledge management. It is a generally accepted concept that the introduction of a creative idea often starts with an individual: “New knowledge always begins with the individual. A brilliant researcher has an insight that leads to a new patent. A middle manager’s intuitive sense of market trends becomes the catalyst for an important new product concept. A shop-floor worker draws on years of experience to come up with a new process innovation. In each case, an individual’s personal knowledge is transformed into organisational knowledge valuable to the company as a whole.” (Nonaka 1991). In the SECI model, the first block is socialisation; an informal learning method involving the development of technical skills through first-hand experience. The creative social individual is the champion of the knowledge-creating company. It is through them that ideas first originate and are learned and shared tacitly before being formalized, diffused, and integrated into the rest of the organisation (Nonaka & Toyama 2003). In fact, organisations in general begin with the entrepreneurial individual who has an economically profitable idea.

Projects though begin with explicitly documented and authorized plans of action sanctioned by the community of board members, engineers, consultants, and other stakeholders, each well informed with the knowledge they require to make their input to the project. As the project emerges, the knowledge decided on at kick-off branches off ever so deeply and gains a different emphasis and focus of attention among each of the stakeholders' tasks. In summary, organisational knowledge management transforms knowledge specialisation of the individual into generalisation to integrate with the company whereas project knowledge management transforms knowledge generalisation of the authorised plans of action into specialisation of the knowledge workers in their particular project tasks.

If one were to put the knowledge-creating company side by side with the knowledge-evolving project, they will clearly see that one's theoretical orientation is the opposite of the other. The knowledge-evolving project is a typical project; one that plans everything in detail at the outset, and develops and assimilates on this guiding knowledge as the project emerges through its lifecycle. The knowledge-creating company is a typical organisation; one that introduces new ideas every now and then to expand outwards and engulf more markets and industries. In both cases, typical means traditional or classical and as defined and interpreted by project management professional bodies such as the American PMI and the British APM. The knowledge-evolving project starts with a whole diversity of knowledgeable stakeholders; the knowledge-creating company starts with the creative individual. The knowledge-evolving project is aware that it is terminal; the knowledge-creating company is aware that it is lasting. Given this theoretical insight, the next section is now ready to decouple the practical foundations of organisational knowledge management from project knowledge management.

2.5 Knowledge Management Practice: Knowing Acts & Knowledge Processes

One of the interesting aspects of Nonaka & Takeuchi's (1995) SECI model of the Knowledge-Creating Company is the dynamic by which knowledge flows within and about. Starting from the knowledge process socialisation, to externalisation, to combination, to internalisation, and back to socialisation for another loop, the flow is a spiral expanding outwards rather than a cycle closing on itself. With every successive loop, knowledge iterates into higher levels of the company; from the individual to the group to the organisation and finally to a community of organisations. Nonaka & Takeuchi (1995) also tell us that the fuel that drives the knowledge spiral are the knowing acts within knowledge processes that transform knowledge forms; where knowing acts are the *de facto* practical implementation of the *de jure* knowledge management processes (Brown & Duguid 2000). Along with imitation and redundancy, Nonaka's (1991) original knowing acts are 'metaphor', 'analogy', and 'model', each serving a particular SECI knowledge process to transform knowledge from tacit to explicit and back. Since Nonaka (1991) there have been many more investigations of knowing acts that corresponding to knowledge processes which transforms knowledge from one form to another. In management literature most of them are attempts to augment the SECI model itself with new knowing acts such as sense-making, reflection, and brainstorming. These studies often do not make it explicitly clear whether specific knowing acts strictly correspond to specific knowledge process (what Cook & Brown (1999) insisted on), as the way specific knowledge process strictly correspond to specific knowledge transformations does. A single set of corresponding knowing acts, knowledge process, and knowledge transformation exists on an epistemological space Nonaka and colleagues call 'Ba' (Nonaka & Konno 1998). So for example, the epistemological space where brainstorming and workshops (knowing acts) are carried out during externalisation (knowledge process) to convert tacit knowledge to explicit knowledge (knowledge transformation) is called ‘dialoguing Ba’. The whole dynamic of knowledge flow of the SECI model suggest three very particular facts about the knowledge spiral: one, new knowledge is initiated by the individual because the spiral usually starts at socialisation; two, new knowledge is ultimately meant for organisations to outgrow their constraints to engulf new markets and industries because the spiral loops outwards as it enters more iterations; and three, knowing acts are the fundamental fuel that drive the knowledge spiral because they are the real-life implementations of knowledge processes.

The SECI knowledge processes of the knowledge spiral of the knowledge-creating company is built on a knowledge exploration policy. The need for knowledge management in organisations in general is to gain competitive edge by instituting creative change and innovation that will ultimately expand the organisation into other markets and industries. Individuals search for or are encouraged to come up with new ideas before sharing it, making it explicit, and finally internalised throughout and outside the organisation. In the beginning individuals would be working on their ideas alone, developing and refining them before officially sharing with groups. Once the idea is absorbed among groups, it’s time to institute it as part of the organisation’s formal activities. In other words, the specialised knowledge of the creative individual becomes generalised throughout the organisation. This is particularly evident in the SECI knowledge processes. This practice of instituting new activates will put the whole organisation at a possibility for success or failure because much of the stable status quo has to change and adapt to the new system. When the organisation succeeds in fully internalising the new knowledge, it has developed and become a bigger better competitor in the market.

The knowledge spiral of the knowledge-creating company is obviously not compatible with how projects work. Unlike the lonesome individual with an undisclosed original idea for his/her organisation, projects tend to start with a complete and explicitly clear knowledge of the whole project in the smallest of details among all the stakeholders. Also unlike the individual in the organisation who is yet to refine and develop his idea, the project charter at project initiation is complete with all the necessary knowledge needed to accomplish the project. The need for knowledge management in projects in general is to deal with the inevitable unforeseen difficulties or opportunities of completing the project on budget, scope, and time. Both the anticipated and the unforeseen problems and potential opportunities give projects their unstable fluctuating environment. The knowledge processes of the knowledge spiral of the knowledge creating company would not be of much help here to stabilise projects because it is explorative in nature – it is designed to induce instability and growth outside constraints. Thus, the knowledge spiral of the knowledge-evolving project is fundamentally different than that of the knowledge-creating company. Its objectives are to induce stability and meet constraints with maximum efficiency all while driving innovativeness and creativity to develop, apply, and improve the prior knowledge set at the project initiation as the project is being realised. It begins with generalised knowledge of the project amongst all the concerned stakeholders, and ends with specilised knowledge of every stakeholder in their respective part of the project after the project has presented itself with all its opportunities and risks. This requires the knowledge processes of the knowledge-evolving project be built on a knowledge exploitation dynamic rather than an explorative one: the knowledge spiral will be opening from the project level and directed towards the group and individual levels, cycling *inwards* with every loop. Every inward iteration gets it closer and closer to the center; which is the point of project completion.

The energy driving the inward flow of the knowledge spiral of the knowledge-evolving project are identified as the *knowledge evolving acts* rather than the organisational based *knowledge creating* *acts*. The earlier philosophical discussion (section 2.3) also tell us that the types of intelligences that go under transformation when these knowledge acts are exercised are from and to extra-genetic (natural) intelligence and extra-somatic (mechanical) intelligence rather than tacit to explicit. So what exactly is the practical relationship between intelligence and knowledge? For every cycle of the knowledge evolving spiral, knowledge is not just evolving in the sense of being assimilated and restructured, but also in the sense of providing *guidance*. In knowledge philosophy this phenomenon is called epistemic relativism: the notion that what is known will affect what one choses to know next and how one comes to know it (Luper 2004). By guiding (a) purpose in practice (recognition, acceptance, rejection, distillation etc.) and (b) interpretation in concept (formulating and adapting of views, models, ideas, solutions, evaluations etc.), coherence and consistency for assimilation and restructuring are instituted. Both (a) and (b) are important aspects of project knowledge management practices: (a) is often talked about as information literacy – defined as "a set of abilities requiring individuals to recognise when information is needed and have the ability to locate, evaluate and use the information effectively" (Dalkir 2011, pg. 142), and (b) is fundamentally the cognitive realisation and comprehending of knowledge to formulate evaluations, solutions, and recommendations. By reason it thus comes to mind that at every knowledge-evolving iteration, it's not just knowledge being evolved, but also, indeed, intelligence – the ability to create, assimilate, accumulate, and manipulate knowledge.

This concludes the practice-based decoupling between organisational knowledge management and project knowledge management; and with it, a particular justification and theoretical orientation for studying knowledge evolving acts empirically is revealed. The next section will summarise the whole of the literature review – the philosophical, theoretical, and practical – and prepare the thesis to design the empirical study.

2.6 The Knowledge-Evolving Project in Summary

Project knowledge management is almost indistinguishable from organisational knowledge management. This is mainly because Nonaka's (1991) *Knowledge-Creating Company*, which is an organisational study of knowledge management, was the one study that whose influence was so powerful that it popularised knowledge management as we know it today. The philosophical doctrine of tacit knowing, the theoretical view of the using knowledge to outgrow the institution, and the practical guidelines of knowledge exploration processes, are foundationally embedded in both of the knowledge management studies of organisations and projects. This might not be a problem in itself, but a knowledge management discipline idiosyncratic to project management needs to be given a chance to introduce new ideas and concepts that are potentially significant to managing knowledge in projects and knowledge management in general.

The knot between project knowledge management and organisational knowledge management has been broken-down into three subject matters; the philosophical foundation, the theoretical foundation, and the practical foundation, all of which conveniently found in the gospel of organisational knowledge management – Nonaka's (1991) *Knowledge-Creating Company*. Using centrally Nonaka's (1991) work, the Literature Review chapter deconstructed organisational knowledge management from project knowledge management; revealing exciting insights with every level of deconstruction. First, philosophically, Sagan's (1977) 'evolution of intelligence' demonstrated itself to be a simpler and more pragmatic philosophical backbone than Polanyi's (1958) 'tacit knowing' for a knowledge management discipline. Where mainstream organisational knowledge management interpretation of Polanyi's (1958) tacit knowing necessitates a *transformation* process to *convert* from one form of knowledge to the other, Sagan's (1977) evolution of intelligence necessitates a *utilisation* of one kind to intelligence to *enhance* the other.

Second, theoretically, the organisation knowledge management maxim that requires the organisation to use knowledge to grow beyond its stable constraints by encouraging the creative individual to explore radically new knowledge so that the organisation may extend into more industries and markets doesn't make sense to project knowledge management. Project knowledge management, according to the unique identity and characteristics of project management as defined by PMI (2013), should use knowledge to meet constraints efficiently and effectively in the typically turbulent project environment by developing and evolving the knowledge set and predefined at initiation by all the concerned stakeholders. Remarkably, it turns out, that the 'Knowledge-Evolving Project' is the opposite of the *Knowledge-Creating Company*. Third, practically, the knowing acts and knowledge processes involved in the knowledge-evolving project are characteristically dominantly exploitative rather than explorative. The knowing acts and knowledge practices exercised in a project environment should be largely epistemically relative; predefined knowledge does not sit there patiently waiting to be developed, it actively guides the knowers in how to next evolve it.

The philosophical, theoretical, and practical orientation of the 'knowledge-evolving project' is now complete (Table 2.1), and the rationale and justification for identifying and investigating knowledge exploitation acts rather than knowledge exploration acts in project environments is reached. The next chapter will explore and establish the knowledge evolving acts that drive the knowledge evolving spiral. The empirical research and methodology are carefully designed and equipped to attain the objective of the study before going to the empirical field. The results obtained and interpretation made following the data collection and analysis leads on to the discussion chapter which will produce and evaluate the final model of the knowledge-evolving project.

	Project Knowledge Management	**Organisational Knowledge Management**
PHILOSOPHY		
Knowledge Philosophy Proposed	Evolution of intelligence from Sagan's (1977) The Dragons of Eden: Speculations on the Evolution of Human Intelligence	The tacit dimension from Polanyi's (1958) Personal Knowledge: Towards a Post-Critical Philosophy
Epistemology Principle	Utilisation of one intelligence type to enhance the other	Transformation of knowledge types from one form to the other
THEORY		
Knowledge Management Objective	Successfully meeting defined constraints	Growing beyond defined limits
Knowledge Management as per Institution Ontology	Terminal life, typically unstable and fluctuating environment. Knowledge management introduced to stabilise project as it emerges	Lasting life, typically stable and routine environment. Knowledge management introduced to destabilize organisations to expand into new markets and industries
Knowledge Spiral	Spirals inwards to signify exploitation of project's knowledge assets as it emerges and takes shape	Spirals outwards to signify exploration of new markets and industries outside the organisation's limits
PRACTICE		
Knowing Acts	Innovative exploitation overtakes innovate exploration	Innovative exploration overtakes innovative exploitation
Knowledge Processes	From generalisation to specialisation	From specialisation to generalisation
FOUNDATIONAL TEXT		
Title Offered	The Knowledge-Evolving Project	The Knowledge-Creating Company

Table 2.1: Deconstructing organisational knowledge management from project knowledge management

CHAPTER THREE: RESEARCH DESIGN & METHODOLOGY

3.1 Introduction

The preceding chapter has formed the philosophical, theoretical, and practical justification and orientation which the researcher of this thesis is immersed in when conducting his empirical research. Philosophically, it reviewed the epistemological difficulties and loopholes associated with the current knowledge management studies in project management, and proposed an alternative perspective that explains how intelligence can exist independent of the knower mechanically (extra-somatically) just as it exists as part of them biologically (extra-genetically). Theoretically, it introduced the ‘Knowledge-Evolving Project’, what it means, how it functions, and what makes it different from knowledge management as articulated in areas of organisational business and management. Practically, it described the epistemic relativism inherent in the knowing acts and knowledge processes of the knowledge-evolving project. The justification and orientation of the knowledge-evolving project directs the researcher’s attention towards the knowledge exploitation overtaking knowledge exploration in project environments. This chapter is devoted to explaining how the study will search for and investigate the knowledge exploitation practices that are exercised by humans and nonhuman artefacts to bring about the knowledge-evolving project. These practices are studied empirically and described as the knowledge evolving acts. They are intended to inform and substantiate the concept of the ‘Knowledge-Evolving Project’.

Designing and implementing the empirical research requires careful preparation and planning besides explanation and justification of the rationale for the methodology and methods applied (Glesne 2011). This necessitates the cogent articulation of the modes of empirical inquiry such as the philosophical stance of the researcher as well as the research, the approach taken to conduct the research, the paradigm adopted to inform and flow through the research, the comprehensive understanding of the research setting and participants, and the logic behind the data collection, analysis, and interpretation of the results. The research design is ultimately what couples the literature with achieving the objective of the research. It is a bridge between the two domains, the abstract and the real, carefully built, brick by brick, to create a wide (extensive) and comfortable (comprehensible) travelled path (presentation). There are many, often overlapping, methods, tools, and techniques to build this bridge. A tabulated arrangement of some sort would be very helpful to examine them all. Created by Saunders, Thornhill & Lewis (2011), aside from being a map to navigate with when designing the research, the most powerful aspect of this arrangement is that it provides a view so wide and inclusive on a single hypothetical model – the 'research onion' – that almost any approach, strategy, technique, method, or methodology can be incorporated. The research onion is divided into 6 layers, each representing a portion (an onion layer) of the research design. The further most layer is the research philosophies and it includes subject matters ranging from positivism to pragmatism to structuralism; the second layer is the approaches such as inductive, deductive, or abductive modes of inference; the third layer is the research strategies or research methodologies such as experimentation, case study, action research, and ethnography; the forth layer is the research traditions, quantitative and qualitative, and the different ways with which they can be conducted; the fifth inner layer is the time horizon of the study, cross-sectional or longitudinal; and the final inner most layer is the data analysis/data collection techniques and procedures to employ, such as interviewing, or surveys. This research thesis does not deploy Saunders, Thornhill & Lewis (2011) research onion as a means of navigation (step-by-step implementation of the research design) as much as it does for mapping (exploring the vast terrain of the various research methods and methodologies). Nonetheless there are two important lessons that can be learnt from Saunders, Thornhill & Lewis (2011) research onion: (i) research processes can be grouped into families, and (ii) these families can be categorised in levels in terms of design, strategy, and implementation.

There are a number of workable guiding research models, frameworks and flowcharts that can be found in books on conducting academic research similar to Saunders, Thornhill & Lewis (2011) research onion; including Denzin & Lincoln (2011), Glesne (2011), Creswell (2013), Flick (2015), and Silverman (2016). The difficulty with so extensive a review of doing academic research is not just the variety of representations of the research process and typical patterns of flow, but also the conflicting terminology under which a research process is classified (Glesne 2011). For example, what Crotty (1998) defines as theoretical perspective is what Saunders, Thornhill & Lewis (2011) calls research philosophy, or what Denzin & Lincoln (2011) calls philosophical assumptions. Similarly, what Flick (2015) defines as a research paradigm also includes qualitative and quantitative lenses in Glesne (2011); and where Saunders, Thornhill & Lewis (2011) defines research strategies, Glesne (2011) defines as traditions of inquiry which is not to be confused with research traditions –qualitative, quantitative, or mixed methods. One can find in the opening pages of Creswell & Poth (2017) the authors addressing this concern. On the other hand it is important to note that attempting to make a research guiding model comprehensible to the researcher and the thesis reader doesn't justify or rationalise oversimplifying it; rather, it requires the researcher to explicitly define and explain what he means by a specific set of phrases to describe a research phase or process. Thus, this research thesis has taken two specific efforts to clarify any implicit or indistinct understandings related to the empirical and methodological research design and implementation: (i) the chapter is divided into the steps taken when conducting the empirical research, ranging from understanding the philosophical stance of the researcher, on to designing the research based on the objectives, philosophies, and possible practicalities, and finally the processes of research implementation; and (ii) interpretation and classifications of every research theory and process are explicitly defined and elaborated.

Practically speaking, an appropriate research methodology must be planned not just ideally based on the research gaps, questions, objectives and aims, but also in orientation with the researcher's availability of time and resources, participants and settings, permissions and clearances, and ethical dilemmas that may appear during the research (Saunders, Thornhill & Lewis 2011; Glesne 2011; Emerson, Fretz & Shaw 2011). Too often those two empirical research conceptions, the ideal and the practical, are left to collide and oppose each other. But rather than viewing such collisions as an incapacity, they can be viewed as opportunities to further enhance and improve the research design (Emmel 2013). The empirical research is conducted on a 'Digitisation Project' in an organisation based in Sharjah emirate. The organisation itself is part of a group of companies across the United Arab Emirates (U.A.E.) and operates a variety of businesses: real estate, jewellery, shopping centres, and currency exchange. The organisation has chosen to remain anonymous, and is therefore from hereon, referred to as 'XAX'. XAX runs a small shopping center and real estate for rent or sale of offices, residential units, and commercial shops. The digitisation project was initiated by the managing director with the aim to completely digitise the maintenance operations in XAX. The maintenance department falls under the operations department with its head office located in XAX itself. The digitisation of maintenance operations in XAX was meant to later expand to cover the rest of the group of companies across the U.A.E. with its control centre in Sharjah's XAX. The researcher himself is also a participant in the research since he is the maintenance engineer. This proved to be simultaneously both advantageous and challenging; advantageous since the researcher is well acquainted with the research setting, participants, and procedures, and challenging because it is vital to maintain an objective stance during data collection and analysis. The challenges in shifting between the researcher mode and the worker mode are well apparent in the field notes. Furthermore, the researcher is not only an insider to the company, but also a member of the digitisation project committee. This not only allowed for the granting of quick and easy access to required information, but also exposed the researcher to specifically the desirable information for the thesis. Yet, it was at the request of the managing director that electronic recording tools, such as sound recorders and video cameras, not be used in the research. The only method the researcher was permitted to record data through during observation was via written field notes. Again, this proved simultaneously advantageous and challenging; advantageous because field noting turns the attention and thought to processes and procedures as they occur rather than in an interview after they have occurred, and challenging because the original empirical research design had to be remodeled and developed to account for these practical limitations.

As far as this research thesis is concerned, the scope of the empirical research is to explore the knowledge evolving acts as they occur during the digitisation project in XAX, and to establish them as generalised knowledge practices in the project management literature. Reasonably then, the nature of this investigation is exploratory, inductive, and qualitative; exploratory because the knowledge evolving acts have not been defined in literature, inductive because they are being discovered and established rather than tested and validated, and qualitative due to their incommensurability and ad hoc nature. Exploratory, inductive, and qualitative inquiries are a suitable candidate for grounded theory research. To draw the full power of the flexibility and independence provided by grounded theory, the research deploys Glaserian Grounded Theory (GGT), which unlike Straussian Grounded Theory that stresses on theory generation, stresses on theory discovery. Data collected for GGT analysis was by field noting following the guidelines and strategies presented by Emerson, Fretz & Shaw (2011). Over a period of five months, data collection and data analysis were cyclical and impromptu, each iteration drawing the study closer and closer to saturation and the definitive results.

Once the knowledge evolving acts were discovered and saturated, a secondary methodology, qualitative document analysis, was deployed over the course of one and a half months for triangulation and theory validation. Qualitative document analysis (or simply document analysis) is a relatively unfamiliar research methodology in the business and management literature. Documentation use in research mostly points to document collection, with document analysis being a separate content or thematic analysis method. A complete document analysis methodology comprises more than that; it is an iterative compounding process of thematic and content analysis with elements drawing from methods such as narrative analysis, frame analysis, tropological analysis, and discourse analysis, all the while paying careful attention and maintaining a watchful awareness on the context of the documents' use, authors, intentions, sources, flow, and creation period, among many other such criteria (Bowen 2009). The term 'qualitative' introduced in 'qualitative document analysis' doesn't mean that it is strictly qualitative; rather, it is to define and describe document analysis as a whole standalone qualitative methodology. Data collection and analysis can be either primarily quantitative or qualitative (Altheide et al. 2008). As such, Qualitative Document Analysis can serve as a complementary method, or as a fully mature standalone methodology. Furthermore, qualitative document analysis can certainly generate interview questions, survey questions, and other research inquires, beside determining and controlling objectives (Glesne 2011). In this research thesis, qualitative document analysis is used as a separate methodology to methodologically validate and triangulate (Denzin 2009; Bryman

2004) the saturated results obtained from GGT research. It is therefore deployed sequentially after grounded theory results rather than in parallel during grounded theory research. A little over 90 documents were collected and analysed against the results yielded by grounded theory research. These documents comprised a variety of types concerning the digitisation project, such as software vendor companies' proposals, project committee email chains, minutes of meetings, and even rough notes by the various project stakeholders. The documents collected and analysed were those that were created before, during, and after the primary research methodology. This is an important aspect for triangulation; the time scope of the empirical domain encompassing the primary methodology includes data that may have been missed before and during grounded theory, and data emerging after grounded theory research.

It must be noted that grounded theory itself has an inbuilt feedback loop of data triangulation for validation and verification, but certainly a methodological triangulation protocol (Fram 2013) by deploying qualitative data analysis adds further credit and transparency to ensure enhanced objective observations and interpretations of the empirical grounds. Authenticity and rigour in conducting the two qualitative research methodologies can be reviewed from the empirical research record attached in the appendices. The record includes situated data as well as expanded data recreated by using guidelines defined by field noting, grounded theory, or qualitative document analysis. It must also be noted that while a literature review is done on the main objective of the empirical study – the knowing acts – prior to the grounded theory research, it was not used to construct a model; rather, it is used to adjust to a predisposed orientation that will direct and focus the researcher on the subject matter of the study during data collection and analysis. Thus, it may be argued that this predisposition might have created a particular bias to the research. Nevertheless, going into the empirical research field completely empty minded and unaware is not a practical workable method of research for a PhD thesis; the research scope, topic, methods, ethical considerations, and work development need to be very specifically and intricately defined and approved before progressing onto the next stages that entail data collection and analysis (Dunne 2011). Hence, this supposed bias serves more to direct and guide the research than skew the process of research towards favoritism or subjective preference. Had this predisposition not been defined and acknowledged, the research target would have been lost many times over during the course of the empirical research.

The rationale, logic, and justification of the methodology, research design, methods of inquiry, research techniques, and their implementation strategies are the concern of this chapter. Designed in layers, the first section discusses the post-positivist philosophical assumption of the research and how it affects reasoning epistemologically, ontologically, and axiologically; the second section discusses the qualitative paradigm and exploratory inductive approach of the research for this thesis; the third section discusses GGT, the primary research methodology implemented for discovery and saturation; and the final section discusses qualitative document analysis, the secondary research methodology implemented for validation and triangulation. Figure 3.1 next page summarises the complete empirical research design. Once the knowledge evolving acts are successfully saturated and triangulated, they will be used as the final building block to construct the Knowledge-Evolving Project framework and establish it as a complete model.

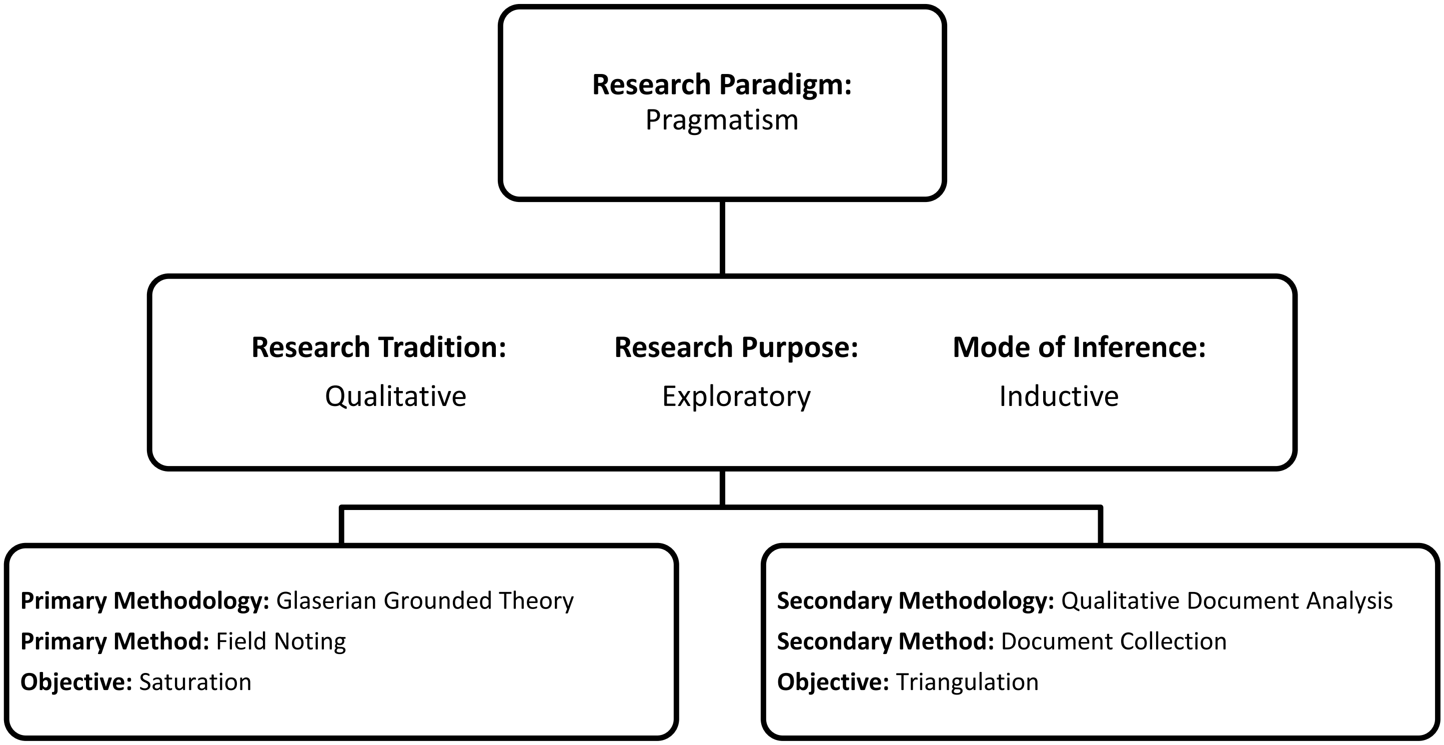

Figure 3.1: Summary of the thesis' complete empirical research design

3.2 Research Paradigm

A researcher's philosophical stance is the fabric of philosophical compositions that assemble assumptions about the nature of reality (ontology), knowledge (epistemology) and values (axiology) around the research (Howell 2013). Within the variety of philosophical stances that a researcher may assume within himself and around the domain of the subject matter of his research, there are a set of comprehensive and thorough philosophical research creeds called the research paradigms. A research paradigm is the philosophical sensing of the researcher that guides his choice of methodology, design, approach, and inquiry methods. Every research paradigm entails a particular justification for a precise way to conduct a research study empirically; in terms of intuitive sensing of the ecosystem, logical reasoning, the tools deployed, data collection, data analysis, result demonstration, criticism and skepticism, creativity and wonder, and writing up. Research paradigms are often presented within a scale of extremes along a vertical, horizontal, and a diagonal axis; at one extreme end is the wholly fulfilled dispassionate objective research/researcher relationship, and at the other extreme is the acknowledged wholly consuming obsessive research/researcher perspective. And just like any philosophical framework, every research paradigm has a capacity to pool different versions of itself with a variety of interpretations of epistemological, ontological, and axiological arguments.

It could be argued that the basic traditional paradigms from which most research paradigms stem are positivism and interpretivism. While positivism assumes that the world is of a monistic objective reality, interpretivism assumes it to be a monistic subjective one. The character of a positivist researcher is eloquently described in Charles Dickens' *Hard Times*:

"THOMAS GRADGRIND, sir. A man of realities. A man of fact and calculations. A man who proceeds upon the principle that two and two are four, and nothing over, and who is not to be talked into allowing for anything over. Thomas Gradgrind, sir- peremptorily Thomas- Thomas Gradgrind. With a rule and a pair of scales, and the multiplication table always in his pocket, sir, ready to weigh and measure any parcel of human nature, and tell you exactly what it comes to. It is a mere question of figures, a case of simple arithmetic. You might hope to get some other nonsensical belief into the head of George Gradgrind, or Augustus Gradgrind, or John Gradgrind, or Joseph Gradgrind (all suppositious, non-existent persons), but into the head of Thomas Gradgrind- no, sir!"

Like Mr. Grandgrid, positivists seek reducing the world into numbers. Concurrently, their methodologies usually depend on statistical predictions, measurable variables, causality, experimental analysis and deductive reasoning. The fundamental assumption of a positivist that formulates such methodologies' relevance and validity is his detachment from what is being researched (Glesne 2011). Interpretivists on the other hand, are those researchers who acknowledge and appreciate their personal involvement and the immersion of other participants in subject matter being studied. Concurrently, their methodologies usually depend on interpretation, incommensurable contextuality, descriptive write-up and inductive reasoning (Glesne 2011). Nonetheless, the real challenge in the interpretivist research paradigm is not just to acknowledge the researcher's involvement and potential bias in the research, but also to detect patterns in an emerging frame of reference that has not been previously defined among diversely developing ideas. Such an encounter is superbly captured in Malcom's (2000, p. 81) *The Tipping Point* who quotes William Condon research on cultural micro-rhythms:

"To carefully study the organisation and sequence of this, the approach must be naturalistic or cthological. You just sit and look and look and look for thousands of hours until the order in the material begins to emerge. It's like sculpturing....Continued study reveals further order. When I was looking at this film over and over again, I had an erroneous view of the universe that communication takes place between people. Somehow this was the model. You send the message, somebody sends the message back. The messages go here and there and everywhere. But something was funny about this."

As William Condone sat for hours and hours watching a four second film with each second divided into 45 film segments trying to observe and detect patterns, he was wrestling with the different potentially developing structures that are emerging. Towards the end of the study, he began to realise an erroneous view that he had been carrying with him throughout his investigation. Communication, he concluded, had a rhythm in the physical movement in addition to the linguistic talking and listening. The physical movement, Condone realised, was actually an instinctive ‘dance’ performed by listeners as well as the speakers. This interesting excerpt demonstrates how in addition to the different points of views elicited from the research participants, interpretivism’s natural inductive mode of inference allows the phenomenon occurring in the research setting to present simultaneously different understandings.

As mentioned previously, there are numerous colourful varieties of research paradigms, each reinforced by their own theorists and philosophers. If one were to list all the paradigms, it is not feasible simply to present them within the traditional spectrum of objectivism (positivism) and subjectivism (constructivism); they simply *would not fit* this prescription. The paradigm spectrum may make sense for the basic varieties of positivism, realism, and constructivism to fall within (Bryman 2008; Denscombe 2008) – such as for example logical positivism, critical realism, and constructionism – but most of the rest of the research paradigms facilitate their own unique ability to learn about the world. Where does phenomenology and hermeneutics that studies the world through shared experience sit on the spectrum?; where does feminist theory, queer theory, and critical theory that attempt to emancipate the world from the ways it behaves sit on the spectrum?; where does post-structuralism, postmodernism, and post-colonialism that attempt to deconstruct the ways the world behaves sit on the spectrum?; where does functionalism and instrumentalism that studies how the world behaves in terms of the practical consequences of these understandings sit on the spectrum? The answer is they don’t. It would simply be a considerably false generalisation. Researchers, especially novice researchers, need to be mindful of that.

Pragmatism as the Research Paradigm

The previous dialogue on the 'knowledge-evolving project' established and discussed in the literature review chapter easily informs the research paradigm required for the empirical study. The philosophical, theoretical, and practical insights reveal knowing acts to be pragmatic in nature; what Argyris & Schön (1974) call a theory-in-use. They are intrinsic practices of project knowledge that are useful to managing knowledge in projects. They just need to be studied and observed closely as they are being exercised so that they may be established in the literature. That makes *pragmatism* the ideal research paradigm to adopt. Pragmatism is in its roots a purely American philosophical stance that started when American scientist and epistemologist Charles Pierce Sanders observed that 'truth' is a measure of our sensory effects rather than the independent nature of that which is being sensed. This 'pragmatic maxim' was later taken up by American professor of psychology and philosophy William James who postulated that 'truth' is actually the usefulness in knowledge rather than the 'fact' in knowledge. For example, Isaac Newton's laws of motion and law of gravity was considered absolute truth mainly to its accurate response to independent experiments and practical use in mechanics and engineering. Only when Albert Einstein put forth his theory of relativity were Newton's laws somewhat abandoned. The gap between Einstein's and Newton's laws are some *two hundred years*. Were the people wrong in believing that Newton's laws are true? No, says William James, because truth is the power of usefulness in knowledge. The next great pragmatist in line was also an American by the name of John Dewey. Dewey's (2007) pragmatism is perhaps that most interesting because it demonstrates how human inquiry involves itself in the knowledge it seeks. That means that knowers are more actively creating knowledge rather than passively observing it (Morgan 2014). The passive observing half is what discovers reality, and the knowledge creating half is what adjusts the reality discovered to be useful. For pragmatists, while independent reality does exist, it is ever changing based on the degree of usefulness it creates in the experiences we encounter. That, however, should not be misinterpreted that reality is totally socially or linguistically created as constructivism or postmodernism suggest. We are not free to create reality as we see fit, instead, we are only free to create 'truth' around our actions and their natural outcomes they come with. This way pragmatism artfully sits outside the belligerent issues between truth and reality (Yvonne-Feilzer 2010), and in effect sits outside the realism/anti-realism spectrum.

Pragmatism as a research paradigm tells the researcher to focus on what really works and how useful is that which works. This speaks directly to the main objective of the research which attempts to study the theory-in-use knowledge-evolving acts, as well as to the insights revealed in literature review chapter. Philosophically, Sagan's (1977) 'evolution of intelligence' has the realistic dimensions of intelligence types rather than the magical dimensions of knowledge forms; one intelligence type is utilised to enhance the other rather than transforming one magical type of knowledge to the other. Theoretically, a traditional instrumentalist project and project management interpretation is more pragmatic than 'projects-as-organisations in terms of providing an ideal project environment where knowledge exploitation overtakes knowledge exploration. Practically, epistemic relativism tells us that, pragmatically, epistemic relativism should be observed as part of knowledge exploitation practices. All these pragmatic foundations (the philosophical, theoretical, and practical) prepare for a pragmatic mindset to study knowledge evolving acts that are inherent in a 'knowledge-evolving project'.

3.3 Research Tradition, Purpose, & Mode of Inference

As per the research design of this doctoral study, the research traditions, research purpose, and mode of inference are the next three layers to go through after the research paradigm. Each of these three research enterprises are first considered separately based on the objectives, aims, and questions of the research thesis, before they are amalgamated together in a melting pot. This matter of design has been prepared specifically for this thesis and does not suggest that all research studies should follow a similar logic. Every research design is unique to the researcher, the research, and the research community.

The research traditions in management consist of two central orientations, qualitative and quantitative methods; the research purpose comprises of three central orientations, exploratory, causal, and descriptive research; and finally, the modes of inference comprise of two central orientations; inductive and deductive research. It is tempting to consider how each element of orientation arising from the research tradition, research purpose, and research mode of inference, are to be guided by a fixed frame of reference or a set of rules and classifications that necessitate for each option to be specifically deployed; such prescription would certainly make things easier to execute. However, qualitative and quantitative research traditions can each follow causal, descriptive, or exploratory research purpose, as much as they can be designed to be inductive or deductive; there are no limits to designing a research approach so long as it is practically and theoretically interesting and worthwhile. Each of the research traditions, research purposes, and modes of inquiry have additional options that are not so commonly used; for example, research purposes also include inferential, predictive, and evaluative approaches, and modes of inquiry also includes abductive and retroductive reasoning. Furthermore, different elements of research orientation can be (and often are) combined such as mixed quantitative/qualitative or mixed causal/descriptive studies. It would be challenging and unusual to deploy an eccentric fusion of, for instance, a quantitative-inductive research, but that doesn't mean that it is entirely impossible or that it hasn't been done (Welch 1999; Cherkasov, Galkin, & Cherkasov 1996). The next three sub-sections will discuss each research enterprise in brief before revealing the combination this research thesis has consolidated and deployed.

Research Traditions

A Tale of Two Cultures: Qualitative and Quantitative Research in the Social Sciences is a book by Goertz & Mahoney (2012) based on their Mahoney & Goertz (2006) article that presents an interesting metaphor characterising the two research traditions, qualitative and quantitative, as two distinct cultures, each with their own set of norms, values, and beliefs. They adopted this idea from Beck (2006) who likens the research traditions to worshiping two different gods. In their investigation of qualitative and quantitative research methodologies, they assemble ten areas that identify where the two cultures contrast: approaches to explanation, conceptions of causation, multivariate explanation, equifinality, scope and causal generalisation, case selection, weighting observations, substantively important cases, lack of fit, and concepts and measurements. Their ultimate objective was to comprehend the cultural misunderstandings between the two traditions, in the hope that this might help researchers to appreciate each other's different pursuits for knowledge.

A qualitative research tradition (or culture) is one that is concerned with recording, documenting, and analysing individuals' own words, the researcher's descriptive observations of their behaviours, the researcher's descriptive observation of a phenomenon they are vested in, or the researcher's descriptive observation of a phenomenon they are apart from (Taylor, Bogdan, & DeVault 2016). The essence of qualitative research is it deals with meaning elicitation, veracity, rationality, and thematisation of the written or spoken word. It resists the reduction of the research setting, participants, and subject of research into numerical variables, preferring to view them as shifting properties of a holistic whole (Tracy 2012). This means that within the qualitative research tradition, the whole of the combined components are more than the sum of their individual parts, in effect allowing for a set of various stimulating and often contradicting interpretations of a single phenomenon under study. Qualitative research frequently stresses upon the need for researchers to systematically abandon what preconceived ideas or predetermined world views they have before entering the research field, and being aware and acknowledging those inflexible biases that could not be disclaimed (Berger 2015). Arguments surrounding the rigour and precision given that qualitative research is always partially prejudiced is a persistent topic of debate amongst qualitative research scholars (Gioia, Corley, & Hamilton 2013). Thus, within the qualitative culture of research, a posteriori tradition is encouraged more than an a priori tradition (Merriam & Tisdell 2016; Saldaña 2015; Robinson 2014).

A quantitative research tradition is one that explains, describes, or explores a phenomenon, around a social setting or outside of it, using data obtained or reduced numerically so that they are engaged within mathematically-based techniques such as statistics, probability, mathematical logic, and game theory (Yilmaz 2013). Essentially, the quantitative research culture deals with numerical computational and calculative analyses of data metricised or transformed into numerical variables for measurement purposes. Typically, a quantitative research study in management subject starts with a theory around a phenomenon complete with hypotheses before entering into the empirical field with specifically designed surveys (usually on a Likert or semantic differential scale) or a prescribed method of experimentation. The objective of analysis in a quantitative study is to forecast future trends, validate hypotheses, or discover previously unrecognised relations between different phenomena (Bryman & Bell 2015), hence, in the quantitative research culture an a prior tradition is encouraged more than an a posteriori one. Perhaps one of the most difficult areas to deal with in a quantitative study is to identify where association does imply causation; two variables may demonstrate statistically similar or parallel trends, but this correlation is not always an indication that one causes the other, it could very well be a logical fallacy (Antonakis et al. 2010; McAfee et al. 2012). The highly logical character of quantitative research appropriates the underlying assumption that requires the researcher to construct and implement pre-determined response categories for the phenomenon being studied thereby effectively limiting the reactions of the participants and the understanding of research phenomena. There are several techniques one can employ to overcome or reduce the consequences of using predetermined response categories, such as designing a variation of closed or open-ended questions, expanding the sample size, and alternating between different measurement scales (Creswell 2013; Bryman & Bell 2015). Furthermore, an awareness of the situation where the phenomenon is being studied, in terms of social context, moral perspectives, physical environment, and participants' worldviews is encouraged before designing the surveys or questionnaires, to reduce response limitations experienced by participants. Unlike qualitative research, quantitative research almost always requires researchers to use statistical software or other such computer programs to perform the scientific calculations. This is not surprising given the current power and speed of computers to perform massive logical calculations in merely a fraction of a second, but its relative inadequacy for performing creative tasks such as semantic thematisation or in-depth description of a phenomenon. Moreover, since quantitative research allows the researcher to collect data from larger samples within a given period of time than a qualitative research study typically permits (McCusker & Gunaydin 2015), the data needed to be analysed quantitatively at the end of the study is usually massive and detailed. It is commonly most rational to perform quantitative analysis automatically through machines such as computers because it saves a lot of time, generates powerful simulations, and eliminates human errors in processes of mathematical calculation and analysis.

Where qualitative research generates results in words, quantitative research generates results in numbers. This does not mean that the various existing methodologies are limited or classified exclusively to each tradition. Certainly, ethnography, grounded theory, case study, action research, and oral history can incorporate one of either types of data, or complement each other in a study, in a sequential or simultaneous flow (Saunders, Thornhill & Lewis 2011; Denzin & Lincoln 2011). Likewise, there is no hierarchy of rigour, excellence, or merit, which assumes one tradition to be theoretically or empirically superior over the other. Each tradition has well addressed set of strengths and weaknesses. Generally, quantitative research is often criticised for its inability to generate different interpretations of meanings, and praised for its objectivity and its simplicity to include large samples from known populations (Denzin & Lincoln 2011). Qualitative research in turn is criticised for its highly subjective involvement of the researcher in the data collection (and therefore bias), and praised for its power to be constructed and reconstructed progressively closer to the research objective with each wave of data collection or step in the data analysis (Maxwell 2012), and its ability to immerse the researcher into in-depth interpretations of the phenomenon being studied (Glesne 2011). While one way to overcome the weaknesses of either qualitative or quantitative research is to combine them in a mixed methods research design, another way is to design and build the study based on either research tradition in a matter that best addresses the objective of the research. For example, Silverman (2016) argues that qualitative based research approaches habitually sacrifice the contextual sensitivity of the research setting to concentrate more on experiences and meanings of participants. His concern could be the exact opposite had the method deployed been field noting instead of interviewing or narrative inquiry. Similarly, Blaikie (2007) regards quantitative research to be inconsistent with or ignorant of the social reality that surround the research due to its firm adherence to the positivist paradigm. But quantitative research can be deployed in various spectrums of realism that account for social reality. Indeed, a survey or questionnaire can be designed exclusively to study a specific social interaction in a particular social setting (Miller & Salkind 2002; Rossi, Wright & Anderson 2013). Each research study is unique in its own way and will require different use of the research traditions, methodologies and methods.

Research Purposes

There are few concepts that provide such a wide ranging view of the research task as the statement of the purpose of the research. The research purpose does not just ask 'why' the research is being done in terms of research objectives, aims, and questions; it also asks 'why' choose one form of inquiry over the other, 'why' develop an interest in the phenomenon, and 'why' learn about the phenomenon at all. There are thus different ways of defining the research purpose. For instance, to Grinnell Jr. & Unrau (2010), the research purpose is determined and conditioned based on how much is already known about the phenomenon being researched, while to Remler & Van Ryzin (2011), the research purpose is determined by recognizing whether one's research attempts to study 'what is' or 'what if', for descriptive or causal studies, respectively. Nonetheless, the most frequently used approach is the 'why' question in terms of the objectives or end purpose of the research, by which the rest of the 'why' inquiries automatically follow in alignment (Gray 2013). As stated earlier there are three basic types of research purposes (there can be more): exploratory, causal, and descriptive. As has been discussed, these three types are rarely mutually exclusive and they often overlap and are a matter of emphasis. Thus, it should be no surprise that a research study often will change and develop over its course of activity. Grinnell Jr. & Unrau (2010) propose a 'knowledge continuum' of the research purposes rather than a categorisation to reconcile with the fact that a research purpose can be "somewhere between". Perhaps the only difficulty with this model is that it creates such a degree of levelling between the different research purposes that it then limits consideration of their possible fusion and potential applications; it is too restrictive to require research should be only either exploratory-descriptive or descriptive-causal work. While an exploratory-causal research study might odd or unusual, it doesn't mean it's impossible.

An exploratory research study is research concerned with studying a phenomenon or elements of a phenomenon which are relatively new or not fully established in the literature. Exploration of a phenomenon requires the researcher to engage with creativity, open mindedness, elasticity, and intuitive sensing (Bernard & Bernard 2012). Occasionally, exploratory studies unexpectedly skew or warp a research investigation into unanticipated subject matters resulting in a change in the original framing of the research questions, objects, and aims, or even the anticipated results and conclusions (Neuman 2014). Exploratory research begins by first realising and acknowledging an undocumented phenomenon that might or might not exist, and identifying the whereabouts and time period when it is likely to occur and to be observed or questioned about. In the course of an exploratory investigative study, the research effort is mostly struggling with the different ways and manners with which to define and interpret the previously un-established phenomenon. Towards the end of the study, exploratory research often institutes themes and categories that explain 'what' the phenomenon is, and propose 'what' consequences this new discovery has for the academic or professional communities. Academics and scholars may later cite such exploratory studies to further understand the identified phenomenon by making their own observations based on the framework constructed, or by testing the validity or generalisation capacity of the framework in various contextual settings. Themes constructed by one researcher to explain a phenomenon do not have to be taken for granted; a separate study that is exploring the same phenomenon may come up with radically different themes that are in accordance with or dispute the previously established one. Exploratory research is likely to be based on inductive inference more than deductive inference since it fits well with discovery and generalization (Bernard & Bernard 2012). Qualitative exploratory studies are habitually more open to evidence in both interpretation and scope usually concentrating on a small number of target participants. While quantitative exploratory studies are capable of covering a wider sample of target participants, there is comparatively less room available for diverse interpretation of meaning (Neuman 2014). Exploratory research initially gathers momentum driven primarily by the curiosity and wonder of the researcher more so than by his sense of criticism and skepticism. It is only at later stages when formulated ideas begin to take shape abstractly and consolidate with the phenomenon under study that the exploratory researchers lean backwards with more hesitation and reluctance to entertain new perspectives.

Where exploratory research ends, descriptive research begins. The purpose of descriptive research is to study the characteristic consequences or course of a phenomenon and the associations of the elements within it; in other words, descriptive research is a study that seeks to accurately describe a phenomenon by investigating its prevalent themes or statistical trends and the relationships between its elements. The phenomenon that a descriptive study investigates is most likely to have already been institutionalised by earlier exploratory studies reported in the literature; nonetheless those established theories of a phenomenon do not have to be adopted. A mixture of exploratory-descriptive study is usually deployed to first explore the phenomenon from a different perspective, identify its main elements and variables, and then later describe its functions and characteristics (see for example Bredin & Söderlund (2013)). A descriptive research study is unlikely to ask 'why' questions around the phenomenon it is studying, rather it is more often concerned with the 'what' inquiries (Shields, Patricia & Rangarjan 2013); for example, a descriptive research study asks questions like: 'What is the popularity trend of knowledge management among project management research in the last 20 years?'; 'What are the top ten topics of knowledge management that most dominated project management research?'; or 'What is the absorption pace of a new topic in knowledge management between organisational knowledge management and project knowledge management?' Once the 'what' categories and themes of a phenomenon has been identified, defined and described, descriptive research can also ask further elaborating questions about 'how' or 'who' (Neuman 2014); for example, 'How strong is the relation between project knowledge management and organisational knowledge management?'; and 'Who are the scholars who advocate for the blending of organisation management with project management?' As well as contrast and compare, descriptive research can also be applied for predicting future trends based on the current and past patterns identified and investigated. Descriptive research is mainly either descriptive observational or historical narratives or is statistically driven with variables identified and studied in a typically a priori fashion before deployment of instruments of measurement on the object of interest in the empirical research field. Perhaps the most challenging aspect of a descriptive study is the struggle to design pre-planned questions and their limited answers to be as informative as possible to obtain the most amount of meaning from the participants. Like a quantitative exploratory research study (although not as odd), a qualitative descriptive research study is possible (Vaismoradi, Turunen, & Bondas, 2013). Descriptive research is not restricted to surveys or questionnaire methods, it can certainly deploy observation, interviews, focus groups, document collection, and other characteristically qualitative research methods (see for example Stettina & Hörz, 2015).

Perhaps the most rational way to move a descriptive research study forward is by framing it into a causal research model; a phenomenon explained by a causal research model is almost always very well received in the scholarly literature. Also known as an explanatory research design, a causal research approach examines the relations of different phenomena or different elements of a phenomenon and asks 'Why is it so?' By extension, this kind of research is not merely testing the validity of its theoretical principles and probability of its predictive success, it is also enriching scholarly knowledge in terms of providing explanations to increase understanding or provide causal reasons that determine what makes it behave or occur in the way it does (Neuman 2014). For example, an explanatory research study investigates questions like 'Why is the popularity trend of knowledge management evident in the project management literature?'; 'Why are these specific ten topics of knowledge management popular in the project management literature?'; or 'Why does a new topic in knowledge management get absorbed into the organisational management literature more rapidly than in the project management literature?'. Such modes of research inquiry ultimately create a certain magnitude of skepticism and criticism during the course of the research, and consequently, they are likely to encourage the researcher to wander further away from the basic concepts and principles of a phenomenon that are already established in the literature. He might even find empirical indications and evidence supporting the complete rejection of the basic premise of the phenomenon being studied as recognised in the conventional scholarly literature. Indeed, this is how explanatory research methods turn into exploratory inquiry, where the research shifts away from attempting to merely explain a phenomenon, to looking for alternatives that define the phenomenon (Creswell 2013). As well as refute or discredit a theory, explanatory research can be deployed to support and sustain a theory, modify and adjust it, or completely transform it (Peng & Lai 2012). In parallel to descriptive research, causal investigations are often statistically focused and driven. The processes followed for either explaining, predicting, or describing a phenomenon are based on different statistical modelling strategies and techniques (Galit Shmueli 2010). Understanding the distinction between each in a quantitative motivated research investigation is important not just because it retains the focus on the research objectives, it also serves as a rationale for meeting the challenge of building the most efficient statistical questionnaires and surveys in terms of question item and response design for data collection, and variable value processing for data analysis. Should there be substantial problems with designing a statistically appropriate model for the specific research objectives, the research can always combine several modelling strategies for better depth of meaning but at the cost of reduced control. Likewise, causal research procedures can also be implemented within the qualitative domain so long as it follows a set of rules and guidelines on how to formulate, analyse and interpret the different types of data (Maxwell 2012).

Modes of Inference

Inference is the cognitive process of reasoning that moves from premise to conclusion by either abstracting the observations made of reality, or by observing the abstractions as they occur in reality. Inference is logical in derivation, and thus flows in consistent and coherent steps of progression. The basic reasoning sequence of a successful coherent flow between steps of inference is often ‘since’ and ‘therefore’; for example: since A is equal to B, therefore B is equal to A. The number of logical nodes for a sound argument is typically two premises and one conclusion; beyond that there can be as many logic nodes between ‘since’ and ‘therefore’ as can be logic bases for ‘since’ and ‘therefore’. In research, for different objectives and aims, different modes of inference can be deployed. Accordingly, inferences can be made to explore, explain, or describe a phenomenon. The two most basic modes of inference are deductive and inductive reasoning. Deductive reasoning starts with adopting a statement or a theory previously constructed by abstractions made out of reality, and logically applies its rules to assess its validity, potential, or consequences, and based on the results, conclusions are then drawn. It is necessary that deductive reasoning guarantees the conclusion reached, since there can only be one common observable reality. Inductive reasoning is somewhat different since it makes claims about abstracted reality which can be interpreted in many ways, and therefore conclusion by inference of induction is not guaranteed. Inductive reasoning functions by extending observed reality into an abstraction of it; a specification is transformed into a generalisation; a single case into an all-inclusive rule. Inductive reasoning starts with adopting a specific aspect of observable reality as its premise, and attempts to develop a theory or a statement in conclusion. For a straightforward means of comparison, one can think of inductive reasoning as a bottom up approach whereas deductive reasoning is a top down approach; ‘bottom’ being observable reality and ‘top’ being abstracted reality. Inductive reasoning works best with qualitative linguistic methods of research, while deductive reasoning is most efficient with quantitative numerical methods.

Thesis Research Policy

The main of objective of this research thesis is to explore the knowledge evolving acts that occur during a project lifecycle. Knowledge evolving acts are specific practices exercised by human and nonhuman intelligence to develop and build on the guiding knowledge that has been predefined during the project initiation and launch. Studies that address knowing acts – what they are, how they come about, and who or what enacts them – are relatively thin in the knowledge management literature. Nonetheless what modest presence they make in scholarly publications on management improves researchers' understanding of their basic and general concepts when exploring them directly in the particular habitat of a project environment. Empirically, knowledge evolving acts take place throughout the project life cycle and are characteristically exploitative. The involvement of different actors (human and nonhuman), their varying knowledge manipulation capabilities, and how predefined knowledge of a project gradually becomes more focused, immediate, and complex as the project emerges, are the desired incidents to be observed and recorded. The nature of such data most probably cannot be reduced to quantitative numbers, and so it is more appropriate that they are investigated linguistically. The preferred research orientation for this investigation then is qualitative, explorative, and inductive; explorative because the knowledge evolving acts of projects (aside from the concept of knowing acts in general) have no presence to-date in the literature; qualitative because words can elicit more meaning and depth of an incommensurable observed phenomenon as it occurs than can statistical modeling techniques; and inductive because while knowledge evolving acts are an inherent practice in project settings, there are no established or defined models, concepts, or frameworks that demonstrate and describe them in project management scholarly publications. One can think therefore of this research design as being at one end of a continuum where the other end is a quantitative-descriptive-deductive design. To put things in to perspective, had this research asked questions such as: 'What are the correlations between the knowledge evolving acts and the knowledge creating acts?' or 'What are the proportions between the various knowledge evolving acts during their implementation in agile project management?', then a suitable research design would have been quantitative-descriptive-deductive, but the questions asked here in this thesis are ‘What are the knowledge evolving acts?’, and, ‘What makes the knowledge evolving acts unique to project management?’

The selection of a qualitative-exploratory-inductive research design is based on its suitability for the discovery of something new conceptually and establishing these ideas in the project management literature. This fusion of qualitative-explorative-inductive research makes sense not only in relation to the aims and objectives of the research, but also to the way the research design is constructed. There is a precision in the structure of alignment achieved between a qualitative tradition’s linguistic research methods, an exploratory research study’s characteristic searching for something yet unrevealed and unidentified, and an inductive mode of bottom up approach (from observed reality to abstracted reality). A qualitative-explorative-inductive research design readily reflects the characteristics of a specific research methodology: grounded theory. The next three sections of this chapter will first introduce research methodologies and methods in general, and then discuss in details the two methodologies and methods used to conduct the empirical research – field noting in Glaserian grounded theory, and document collection in qualitative document analysis. The discussion is mostly about the research protocols of Glaserian grounded theory and qualitative document analysis as implemented by the researcher. Both of the grounded theory and the qualitative document analysis approaches taken are an original aspect of this thesis. Grounded theory served as the primary research methodology with the specific objective of exploring and saturating the knowledge evolving acts. Qualitative document analysis served as the secondary research methodology with the specific objective of validating and triangulating the knowledge evolving acts. Both grounded theory and qualitative document analysis are the main building blocks of the research design and the focus of the methodology chapter.

3.4 Research Methodologies & Methods

As discussed earlier in this chapter, there is no one clear cut definition of every research family. Different scholars describe and integrate research families differently (Glesne 2011). The research thesis itself makes these distinctions to suit the specific design and deployment of this particular empirical research. So far, the four research families that have been described above are the research paradigm, the research tradition, the research purpose, and the research mode of inference. The research methodology is the fifth research family of the research design, and is the research's best practices according to the objectives and the philosophical view of the objectives. Research methodology includes research disciplines such as case study, grounded theory, action research, ethnography, life history, and survey. Research methodologies inform the sixth and final research family – the research methods – what data to collect and how to articulate and integrate it appropriately according to the selected methodology (Glesne 2011; Saunders, Thornhill & Lewis 2011). The methodology will in its turn, present the analysed data either for further collection or further analysis. In simpler terms, the research methodology is a discipline of systematic analysis of the data collected based on the research methods. Research methods, for example, include questionnaire surveys, interviews, focus groups, and document collection.

While conducting the empirical research, the researcher has noted with interest the peculiar manner with which the research methodology and research methods work together. The principles, rules and practices in each of the research methodologies and research methods have their own sphere of influence: while the research methodology controls the decisions related to data analysis, the research methods control the decisions related to data collection. For example during the beginning stages of grounded theory, the researcher realised that his data collection were more pertaining to filed noting rules such as depiction strategies, jottings, and point of view narration; and his data analysis were more pertaining to the grounded theory rules such coding paradigms, the constant comparison method, and memoing. This is not to say that grounded theory offered no data collection rules; theoretical sensitivity and theoretical sampling are a major pillar of grounded theory research. Similarly, field noting offered several data analysis rules such as extended noting and a shift between the observer/writer modes. Generally speaking thought, distinctions can be made between what contributes to research methods and what contributes to research methodologies. Research methods incorporate and steer physical sensing tools, recognition faculties, repository applications, and reliability assessments – such as eliciting, recording, transcribing, cleaning, and validating – to search for, collect and verify successfully the relevant research data. Research methodologies incorporate and steer the abstract reasoning mechanisms, rules, and convictions – such as thematising, correlating, reflecting, and generalising – that process the data input by methods. Thus, research methodologies' commitment to the research paradigm and tradition is overall more theoretical than practical; in contrast, the research methods' commitment to research paradigms and traditions is more practical than theoretical.

Although it is comparatively straightforward to categorise most research inquiries under either the research methodologies family or the research methods family, there are some research inquiries that blur these distinctions by occupying categories between both families. For example, simulation based research (Harrison 2007), discourse analysis (Gee 2014), narrative inquiry (Silverman 2016), and (perhaps most notably) participant-observation (Glesne 2011), can be neatly categorized into both a research methodology and a research method. On the one hand this has the advantage of establishing a fully inclusive and pre-coupled research methodology and method, but on the other, has the disadvantage that it then is harder to introduce these methodology-method hybrids to adopt other methodologies or methods. For example, participant-observation is almost always primarily based on field-noting. Interviewing and focus groups can certainly add credit and rigour to participant-observation, but cannot be used as the primary methods. Similarly, it's difficult to integrate participant-observation with other methods under grounded theory, case study, or action research methodologies. Nonetheless, heterogeneous research methodology-method hybrids and homogenous research methodologies and research methods can both be designed creatively and flexibly when it comes to decisions related to triangulation. This is perhaps because triangulation itself is a flexible process that can be implemented within many different research protocols.

There are four main types of triangulation which are frequently discussed in the management research literature: data triangulation, which leads to gathering data by using different sampling strategies, units of analysis, and across an expanded variety of space, time, and participants; investigator triangulation, which refers to the deployment of more than one researcher to study one research topic; theoretical triangulation, which is the use of more than one theoretical and philosophical research positions when interpreting data; and the most commonly used, methodological triangulation, which refers to the use of different research methods with the option of integrating the different methods under the same methodology (within-method) or integrating the different methods under different methodologies (between-method) (Bryman 2004; Denzin 2009). Usually, methodological triangulation is implemented in research as a between-method combination of qualitative and quantitative inquiry; for example, case study interviews could be triangulated by survey questionnaires. Such qualitative-quantitative triangulations eloquently support descriptive and explanatory research where the study topic is established in the scholarly literature, but offer less support for exploratory research, where the topic of study is relatively new, unfamiliar, or even unusual. Unless the research is longitudinal, it is perhaps wiser to triangulate quantitatively the interview questions of a subject matter that has strong presence in research publications rather than subject matters that do not. This is because quantitative research usually gains credit by investigating well established and conventional research topics rather than unusual or new topics of research. Furthermore, designing a quantitative research investigation for a recognised research topic is made easier to implement and simpler to defend due to the availability of various models, prototypes, frameworks, and theories, with which one can draw from before transforming their premises into statistical models for analysis and interpretation. Exploratory research is arguably better suited to qualitative triangulation.

Qualitative triangulation is conducted in this thesis. After discovering and saturating the knowledge evolving acts using a primary methodology, GGT, the knowledge evolving acts are triangulated by deploying a secondary methodology, qualitative document analysis. The primary research method used is field notes rather than interviews for two reasons: (i) it is better to observe the inherent and subtle knowledge evolving acts as they occur rather than after they have occurred to better understand their nature (Glesne 2011), and (ii) the managing director of the organisation being studied requested that no digital recordings (such as video cameras, voice recorders, or even pictures) be used. The secondary research methodology deployed is qualitative document analysis. Certainly, GGT could have absorbed both field noting and document collection methods, but methodological triangulation implemented as ‘more than one method’ under ‘more than one methodology’ potentially has more weight than simply applying ‘more than one method’ in terms of interpretation and analysis of methodically and systematically gathered data. This way, the researcher has the opportunity to engage with the empirical study from more than one viewpoint, gathering data with several perspectives in mind. Qualitative document analysis, like participant-observation, is a research methodology that has developed a number of distinct research methods.

Further to the benefit of being a pre-coupled research inquiry, it has an influential appeal to researchers as a means of triangulation because it seems to be the qualitative counterpart to the quantitative surveying methodology-method hybrid in terms of being a 'full package' system of data collection and data analysis processes. The saturating power of grounded theory and the triangulating power of qualitative document analysis, occurring in that order, exhibit particular significance for researchers investigating and interpreting empirical evidence. Saturation is reached when the study contains enough information to be replicated, when the ability to access more data is permissible, but more data does not equal new data, new codes, or new themes (Fusch & Ness 2015). There is no one universal scheme that informs the attainment of data saturation in terms of sample size or diversity, nor is there a fail proof scheme that informs in terms of data thickness (quantity) and richness (deep and intricate). Denzin (2009) defines triangulation as the analysing of the same empirical event from varied perspectives to explore the different hidden levels. In several respects, this is similar to descriptions of processes of saturation. However, triangulation is not simply another method of saturation (Fusch & Ness 2015), and actually has the capacity to achieve a higher level of saturation. This is because the same phenomenon as realised and explained through the lens of grounded theory lens is then reconciled with the concepts achieved through a qualitative document analysis lens. The double lenses of saturation is what leads to comprehensive triangulation; a directed saturation in which both scopes align to provide the best focus (accuracy) and zoom (precision) of the phenomenon being studied.

Field noting exercised under GGT for saturation, and data collection exercised under qualitative document analysis for triangulation, and the rationale of using these systematic methodologies and methods in this empirical research for the thesis are the subject matters of the following two sections. Much of the theoretical and practical value of the research design relies on its implementation in the selected research setting. This chapter argues in favour of the approach followed to achieve the study's objectives, as well as articulating the research ethics taken into consideration. Then, the ultimate saturated triangulated results of the empirical research methodology and design are reported in the next chapter.

3.5 Primary Research Methodology: Glaserian Grounded Theory

The Story of Grounded Theory

During the early 1960s, two sociologists – Barney Glaser and Anselm Strauss – conducted a four year study that investigates the interaction between terminally ill patients and the hospital staff in hospices. Glaser and Strauss were particularly discontented with the underlying assumption of research methods in much of the social sciences at that time, where they argued there was a tendency towards exaggeration and overemphasis on the validation and verification of theory over the actual generation of new theory (Moore 2009). They argued that equal interest and merit should be given to research that prioritises theory generation as to research that concentrates on theory validation. This problem encouraged Glaser and Strauss to probe the deeper consequences in terms of a priori and a posteriori inquiries. They argued that by concentrating on the validation and verification of theory over the generation of theory, sociological research was being forced to logically deduce theories based on prior assumptions and preconceptions adopted from previous published studies rather than discovered from the empirical site of research itself. Glaser and Strauss went on to craft a new research methodology that met their concern for conducting research on dying patients and called it the 'constant comparative method' (Glaser & Strauss 1967). As the name suggests, it requires the researcher to obtain data from the empirical study site and analyse and interpret it through systematic cyclical iterations of comparison until conceptual categories and themes begin to emerge, which will then, give rise to a generalised theory. This systematic method that allows the emergence of concepts, hypotheses, and propositions from grounded data first appeared in Glaser & Strauss's (1965) *Awareness of Dying*. It later picked up a lot of support and enthusiasm from the academic community which motivated Glaser and Strauss to develop and package their research method into a fully mature methodology published in their 1967 book appropriately titled *The Discovery of Grounded Theory* (republished Glaser & Strauss 2017).

It should be noted that grounded theory is not a general method of data collection and data comparison. There are underlying rules and procedures to systematically and rigorously generate and control the development of new theory grounded in data. It is specifically those rules and procedures that later divided Glaser's and Strauss's individual interpretations of what constitutes grounded theory research. The division in the beginning was not evident to the wider research community although it was clearly there from the outset (Walker & Myrick 2006). Finally, in 1990, Strauss made the separation public when he published *Basics of Qualitative Research: Grounded Theory Procedures and Techniques* co-authored with Juliet Corbin. Glaser did not take it well in the following years, and his communication with Strauss was understandably disconcerting (Kenny & Fourie 2014; Walker & Myrick 2006). Glaser's formal reply was published in 1992 in *Basics of Grounded Theory Analysis: Emergence vs. Forcing*. By that time, grounded theory was evidently split into two approaches, Glaserian (or classical) grounded theory and Straussian grounded theory. The following years witnessed further separations and divisions amongst the community of scholars practising grounded theory research, most popularly Kathy Charmaz's (2000) constructivist grounded theory, and the several approaches advocated in Judith Wuest's (1995) feminist grounded theory (Evans 2013). Today, Barney Glaser and his colleagues still write to explain and defend his particular interpretation of grounded theory (Glaser 2013; Glaser 2014; Glaser 2015) – which happens to be the original Glaser & Strauss's (1967) interpretation – and critique those who attempt to dissolve it in to other qualitative strategies (Walsh et al. 2015). In fact, there is a whole journal – *Grounded Theory Review* – dedicated only to classical grounded theory. Anselm Strauss passed away in 1996, and his colleagues continue to espouse Strauss's version and vision of grounded theory as well (Morse et al. 2016).

It is often debated that the disagreements between Glaser and Strauss that resulted in the methodological split of grounded theory is a result of the growth of new philosophical assumptions (Newman 2008; Levers 2013; Birks & Mills 2015). The 1970s and 1980s witnessed a surge of postmodernist intellectual ideas that reinforced and amalgamated various social, linguistic, and phenomenological constructivist philosophies. Postmodernism, post-colonialism, and post-structuralism were at their height in the 1960s through to the 1980s, although much of their influence on the business and management literature followed in subsequent decades (McHale 2008; Hatch & Cunliffe 2013). Strauss himself was deeply influenced by symbolic interactionism (Chamberlain-Salaun, Mills, & Usher 2013). Consequently, various qualitative data analysis techniques were synthesized into what is believed to be an obsolete positivist original grounded theory in an attempt to modernise it to catch up with a world going through a major shift in paradigms across diverse areas of activity and thought, academically, economically, politically, and culturally. This modernising of grounded theory was advocated not just by Strauss & Corbin (1990), but also by various scholars from the field of research. However, the original grounded theory was in no way a typical positivist paradigm, which is the principle justification that Charmaz (2000) makes to argue her case for a constructivist grounded theory. While the original and first grounded theory methodology was conducted based on a realist paradigm by Glaser and Strauss, it has the potential to support and be implemented with success as can other philosophical paradigms relevant to the research (Holton 2008). Indeed, this is the fundamental power of grounded theory that Glaser consistently praises and cites. His conviction is that advocating qualitative data analysis and specific coding families to grounded theory and packaging it as an independent methodology for a constructivist approach, or espousing quantitative techniques and specific coding families to grounded theory and packaging it as an independent methodology for a positivist approach is what weakened grounded theory and turned it into a data forced methodology. Grounded theory is neutral; it allows for various methods of data collection coming from all possible philosophical assumptions present in the diversity of idiosyncratic interpretations made by the researcher whether through data comparison or correlation – be it positivistic or interpretative. This way grounded theory can certainly accommodate all philosophical backgrounds, without the qualitative data analysis enforcing elicitation techniques that vandalize the data, or the defined coding families that coerce it into adopting predetermined premises.

One particularly seemingly vexed criticism leveled at Glaser to counter argue the neutrality of classical grounded theory in defense of Charmaz's constructivist grounded theory is that researchers can never attain absolute objectivity in observation and analysis, that their methods are always contaminated by their inevitable bias, and that theory construction is as certain as theory discovery is not (Bryant 2003). What Bryant (2009; 2003) overlooked (perhaps intentionally) is that throughout her career, what Charmaz (2017; 2014; 2006; 2000) considers researcher bias, is actually what Glaser considers the researcher's philosophical viewpoint, and that what contributes to theory construction rather than discovery are the very qualitative analysis methods she provides to minimise researcher bias. To summarise the potential compatibilitiy of the two approaches, theory discovery (by Glaserian grounded theory) + qualitative data analysis tools (from constructivist grounded theory) facilitates creative and rigorous theory construction.

Between Glaser, Strauss, Charmaz, Corbin, and Wuest's versions and interpretations of grounded theory, no methodology is totally superior to the other. It all depends on the philosophical underpinnings and assumptions of the researcher and the objective and aims of research. The overall evaluation that researchers make of these different approaches depends on whether they judge the original grounded theory as timeless in its ability to absorb different philosophical paradigms, or obsolete and in need of constant reconfiguration so that it could meet with "contemporary intellectual trends and movements" (Strauss & Corbin 1994, p. 276). This research thesis adopts the former view not just to fulfill the research objectives from a particular pragmatism paradigm, but also out of an admitted prejudice in its favour.

Adopting Glaserian Grounded Theory

Grounded theory follows a systematic route to discover theory grounded in data; hence the name, grounded theory. Researchers practising grounded theory go through controlled yet chaotic iterative cycles of data collection, coding, categorising and comparison in order to generate their theory. This way, concepts and properties and their relationships are not only generated, but also provisionally tested (Mishra & Bhaskar 2010). Glaser & Strauss (1967) observe how previous methods of social research have predominantly focused on verification, not discovery. Grounded theory therefore allows the researcher to start with no idea of what the answers to the research questions might look like. Grounded theory's data collection principles and procedures allows the researcher to attain data not only from empirical grounded research, but also from literature review of the topic, and from the researcher's own notes and deploy it within a constant comparative cycle of analysis and interpreations (Elliot & Higgins 2012). While it is fundamentally a qualitative method, Glaser & Strauss (1967) clearly stated that their position on the qualitative/quantitative clash is neutral, in fact, both forms of data collection are viable for both verification and generation of theory. As was previously discussed, since it was first published, grounded theory has become dispersed into many different models. The constant remodelling of grounded theory was seen as a way to adapt its relevance with evolving research mechanisms (Charmaz 2006). Yet this remodelling has drifted so far off in misinterpretation of it with qualitative data analysis, it is no longer grounded theory (Glaser & Holton 2004). Updating grounded theory at the expense of misusing it has resulted not only in contradicting its basic principles, but also in adding independently invented methods (Goulding 2009). To address this issue, it is important to note that the problem of grounded theory is not one of modernisation or adaptation into newer more relevant research mechanisms, it is a problem due to the split between its founding fathers. Grounded theory's split was not unexpected; there were obvious disagreements and debates between its original authors concerning the data analysis phase (Evans 2013). Perhaps this could be attributed to the different academic background of each (Goulding 2009). When Strauss & Corbin (1990) released their independent versions of grounded theory, Glaser (1992) called it 'full conceptual description', not grounded theory (Walker & Myrick 2006). Straussian grounded theory favoured the use of systematic tools that Strauss & Corbin (1990) developed to direct the researcher more into construction than discovery of theory, thereby closing some windows of opportunity for engaging in more exploration and assessment. By doing so, Straussian grounded theory guarantees the route for developing theory that has been found helpful for numerous, anxious PhD researchers (Walker & Myrick 2006). Glaser (1992) stayed true to the original model that stressed discovery and gave freedom to the researcher during analysis. GGT privileges attitudes of open discovery and inductive reasoning over any systematic approach that might even remotely limit it. In doing so, however, GGT depends highly on trusting that the research will eventually arrive at a theory. What followed later was a 'dip and skip' method of cooking Glaserian grounded theory with Straussian grounded theory alongside an ad hoc mixture of various methods of qualitative data analysis resulting in a mutilated version of grounded theory, if indeed there is any grounded theory left in it (Martin & Gynnild 2011; Glaser & Holton 2004).

To understand the difference between Glaserian and Straussian grounded theories in action (and therefore avoid the 'dip and skip' approach), one needs only to examine the coding schemes between both practices. GGT has three coding levels: open (stage one substantive), selective (stage two substantive), and theoretical coding. Similarly, Straussian grounded theory has a three level subdivision – open, axial, and selective – coding scheme. At first sight, the two coding practices of Glaserian GT and Straussian GT may seem without much substantial difference. But coding is more complex than can be apprehended in one glance. Glaserian GT progresses from empirically collected data to conceptually discovered theory by going gradually through all three levels of coding and comparison. It is at the last level of coding (theoretical coding) that the researcher may become more confident that his core categories have emerged and are ready to begin writing the theory. At this point, Glaser (1978) offers 18 coding families that one may use at the stage of theoretical coding when the core categories have emerged: the six Cs, the process, the degree family, the dimension family, type family, the strategy family, interactive family, identity-self family, cutting point family, means goals family, cultural family, consensus family, the mainline family, theoretical family, ordering or elaboration family, unit family, reading family, and models family. Straussian GT, instead, progresses in two coding levels of theory construction from empirical data – open and axial coding, and one coding level of theory validation – selective coding. Second phase axial coding of Straussian grounded theory is the counterpart of third phase theoretical coding of Glaserian grounded theory. Strauss & Corbin (1990) offer 4 coding paradigms: the phenomenon itself being studied, the conditions related to the phenomenon being studied (in terms of causality, context, or intervention), the strategies and actions to manage or handle the phenomenon being studied, or the consequences of the interaction of the phenomenon being studied with its ecosystem. Along with Glaser's (1978) open, selective, and theoretical coding, and the coding families, he introduces modifiability, theoretically sensitivity, and sorting. Strauss & Corbin (1990) conversely, introduce dimensionalising along open, axial, and selective coding, and a specific coding paradigm, the conditional matrix. It is easy to see now that the two coding and analysis approaches of Glaserian GT and Straussian GT are highly incompatible for combination in one research design. Fusing Glaserian and Straussian GT is highly erroneous and is likely to yield a conflicting research methodology and research results.

Nonetheless, Glaser (2009b) is more critical of qualitative data analysis techniques blocking grounded theory than of mixing Glaserian and Straussian coding schemes, and for good reasons; it is easy to tell the difference of either Glaserian GT or Straussian GT coding systems, but it is hard to avoid engaging in qualitative data analysis techniques due to confusions in analysis phases between Glaserian, Straussian, and the constructivist GT. In Glaser's point view, qualitative data analysis' focus on descriptive collection and assessing of only 'real data' by engaging in data collection rigour, participant voice analysis, narrative breakdown procedures, or assessing how type data could drown GT (Glaser 2009b). The basic premise of the original GT can be reduced to the phrase: *all is data*. The effects of verification, correction and saturation are themselves ingrained within the spiraling process of comparative analysis of emerging theory, and should not be imposed on by altering data sources or data analysis with external qualitative data analysis techniques (Glaser 1978). In contrast, Charmaz's (2000) constructivist grounded theory is presented as an alternative approach to Glaser and Strauss's "objectivist grounded theory". Principally, a constructivist grounded theory is based on the idea that neither data nor theory are discovered but are constructed by the researcher who is immersed in the social surroundings of the research. Constructivist grounded theory therefore attends to research bias as human constructs that cannot be totally avoided, and so create the need to engage in worrisome doubts about data accuracy and purification in order to attain objectivity. As such, constructivist grounded theory ignores the major pillar that makes grounded theory, indeed, grounded theory – GT is the product of transcending abstraction, not accurate description (Glaser 2002). Attempts to establish accuracy from various data sources by all kinds of methods of external qualitative data analysis do not only block data from emerging, but actually *forces* the researcher to 'compose the story'. What needs to be made clear here, first of all, is that bias, is just another variable to GT (that may or may not be useful) which inevitably surfaces during the constant comparative method. Secondly, GT's premise of abstraction is generated through a series of steps that makes the generated theory as objective as is humanly possible to achieve (Glaser 2002). Charamaz's constructivist grounded theory therefore does not correct researcher bias, all it does is remodel GT in a constructivist variation of qualitative data analysis techniques.

To summarise the argument on GT, Glaser (1978) has declared: "The goal of grounded theory is to generate a conceptual theory that accounts for a pattern of behavior which is relevant and problematic. The goal of grounded theory is not voluminous description, nor clever verification." Grounded theory is grounded in its explanatory power, not descriptive analysis. More than any element of GGT; this research thesis adopts its exploratory power: its openness and freedom to conceptualisation of data and of discovery theory. Briefly, there are six exploratory tools and techniques of data collection and analysis of GGT that the researcher needs to be equipped with before moving into the empirical research setting: coding, theoretical sensitivity, constant comparative method, delimiting, memoing, and sorting.

Glaserian Grounded Theory Tools & Techniques

Doing Glaserian grounded theory is simultaneously highly exhilarating and wholly terrifying because it preserves that particular characteristic addictive thrill of open exploration. The exploratory methods assembled within grounded theory provide the necessary tools and instruments to charge the empirical grounds, and offer intelligent and thoughtful reflection to the utilisation of these tools and techniques. In the following paragraphs, a 'how to use' dialectical tone is assumed to demonstrate the astonishing simplicity of what looks on the outside like a very complex research process. But before pondering further on the strengths of GGT, it is important to first address the contentious issue of the role of literature review in classical grounded theory. Admittedly, it was somewhat unhelpful of Glaser & Strauss (1967) to advise against using extant literature review on the substantive area of research, when engaged in the early stages of a grounded theory study. Glaser (1998) makes this declaration fiercely by providing the two dictums of literature reviewing in grounded theory research – GT allows literature review of the substantive area only during the later stages of sorting and writing up. Glaser's argument is that extant theory review can impose concepts on the empirically emerging theory and perhaps contaminate it. This is quite unusual for any type of research; literature reviewing is not solely for the purpose of learning about the subject matter being researched, it also functions to 1) orient the researcher's senses to direct the research in terms of objectives, aims, and questions, 2) provide the researcher with the necessary skills to do the research on the subject matter, and 3) informs the researcher if the subject matter is not being unnecessarily rediscovered –which is a crucial and deciding factor for this thesis (Dunne 2011). Literature review is especially important and essential for doctoral candidates. Necessary courses of action such as approvals, progression milestones, funding, supervisory decisions, and thesis structure write-up are among the many factors that depend heavily on conducting a comprehensive review of the literature. In PhD research, the area of proposed study has to be rationalised and defended before authorisation is obtained to conduct the empirical research. Glaser (1998) describes grounded theory as research that is empowering and free, but this claim does not adequately cover the matter of literature review. Should researchers only be free to engage with the substantive area of research through literature review only after it is too late? This is not a simple argument to maintain on Glaser's behalf, particularly in the context of PhD research. This research thesis effects the application of five arguments to contest the tyrannical perspective on literature review promoted by GGT: (i) extant review of the literature on the substantive area is not possible if the substantive area has little or no presence in the available literature, so there is a low risk of emerging theory contamination; (ii) literature review prior to grounded theory research is not aimed at investigating the substantive area, rather it is aimed at the philosophical and theoretical orientation and justification that will help identify and recognize it, should it occur empirically; (iii) being open minded is vastly dissimilar to being empty minded, the difference being the active and effective engagement in literature review prior to entering the empirical research field (Dunne 2011); (iv) the researcher should endeavour to be reflexive and aware of the danger of the imposition of predefined theories on the emerging theory (McGhee, Marland, & Atkinson 2007); and (v) the literature review itself can serve as data to generate memos along with the use of the constant comparative method (Glaser & Holton 2004). The quest of literature review in project management and knowledge management that this research thesis took at the beginning of the doctoral research study was to identify the area of interest and formulate the research questions, aims and objectives. This did not result in the construction of models or frameworks for the study, rather, it provided the researcher with a mental map and justification of what to look for in the domain of interest. As the core-categories started to emerge, the review of the literature moved closer and closer towards the substantive theories. Once the core categories were saturated by grounded theory and triangulated by document analysis, the literature review expanded further outwards towards looking for concepts to create and construct the final theory. Should Glaser come across this research thesis, the researcher would like to make clear that more than anything, it is the force of curiosity and anxiety that compelled the premature engagement in literature than GGT allows.

Aside from the controversial matter of literature review, executing GGT is simple and rewarding. Its processes and techniques have an inbuilt system of data analysis and data validation. There are no restrictions to the methods of data collection; one can employ any means of collection such as interviews, documentation, focus groups, and field noting. To understand the mechanisms of GGT, one must first understand the machinery. There are five basic machines in GGT: coding, constant comparative method, theoretical sensitivity, memoing, and sorting. These machines operate in a cyclical and iterative fashion all of the time. In one day, one machine informs the other, which directs the other, which instructs the other, and back again. The periodic feedback rules and procedures for using all these machines have one thing in common: all is data. Whether that data is an interview transcript, an observation, a quotation, or a document excerpt, it is important to resist their reprocessing in an attempt to attain accuracy and rigour; those effects will arise automatically (Glaser 1998a). The first machine to consider is called ‘coding’. Coding is the summarising of a one line or one sentence into a couple of words. To reiterate the process, there are three levels to coding that flow in sequential order: open coding (stage one substantive coding), selective coding (stage two substantive coding), and theoretical coding. Open coding is the coding of more data in every possible way; there are no restrictions to data collection or to data coding (Glaser 1992). One is focused more on the exploration of all incidents than it is on sensing the emergence between them, therefore it is important that at this stage the research is open minded and accepting of all incidents. Open coding allows the researcher to stay in an explorative mode oriented more towards discovery than construction. The codes themselves are descriptive of the exact and literal incidents that occur. The researcher is allowed the freedom to code in every way possible so that the research objectives can be studied from different angles. The next stage, selective coding, is more focused on sensing emergence than on exploring more incidents. Selective coding summarises the apparent relationships between incidents in a couple of words, in one line or one sentence at a time. During selective coding, the researcher starts to focus on specific categories at the expense of irrelevant others. Towards the end of selective coding, the core categories emerge: categories that best hold the potential to attain the study's objectives and answer the research questions. Core categories are then further developed through theoretical coding; a highly generalised and conceptual technique of coding (Glaser 1992). Theoretical coding involves summarising the incidents that occur – in one line or one sentence at a time – in terms of the core categories emergent at the end of selective coding. Theoretical coding provides the framework, model, or theoretical arrangement of the core categories (Walker & Myrick 2006).

During the three stages of coding, it is important to note that it is not wise to suddenly jump from one coding level to the next. It is better to phase-in the coding stages between levels; by conducting selective coding along open coding towards the end of open coding, and selective coding along theoretical coding till midway (or perhaps throughout) theoretical coding. This is important not just to ensure a smooth transition between levels, but also because towards the end of selective coding and all the way up until the grounded theory research is completed, there are two processes that need to be implemented to ensure that attention to core variables is given the most weight and focus. These processes are called ‘delimiting’ and ‘reduction’. Delimiting is the process of concentrating on and recording of those incidents that are directly related to the identified core variables, and overlooking the incidents that are not. Consequently, more attention is given to analysis than to collection; the researcher is mentally analysing data directly as it is being collected in the empirical field. Delimiting is followed by reduction, which is the process of discarding all the previously analysed categories and their properties that do not pertain to the core categories (Holton 2008). The smooth phased transition of coding (between selective and theoretical) keeps delimiting and reduction parallel to and on level with the transition without inducing any sudden steps that might disturb their operation.

The coded incidents in all three stages of open, selective, and theoretical coding, are subject to the hallmark machine of grounded theory called the ‘constant comparison method’. At the end of the day, after collection and coding, incidents and their codes are compared in search for patterns (Glaser 2001). At the beginning of coding, incidents are compared to incidents. This will generate categories and properties of each category. After primitive categories emerge, they are strengthened by comparing them with incidents, and later by comparing them with other categories. This process is by no means a linear one. Categories and their properties emerge all the time at every step, and it is the job of the researcher to identify and observe their significance in relation to the phenomenon being study. At no time during the open and selective coding this process ceases or becomes sequential because there can always be new incidents that have new consequences on the phenomenon. New incidents certainly entail new categories and new properties. The decisions of how to identify, code, interpret, and compare data depends on a machine called theoretically sensitivity. Theoretical sensitivity is the ability of the researcher to make sound judgments to matters related to data collection and analysis: where to look next and how to analyse in relation to previous data collected (Glaser 1978). Theoretical sensitivity is by far the most exciting aspect of grounded theory because it engages the researcher's intuitive sensing when present in the research field. Certainly, it takes time for a researcher to develop focused research sensitivity, which is why open mindedness and acceptance of all incidents is encouraged at the beginning of grounded theory, but once it's developed, it effectively draws the researcher to integrate theoretical insights from dispersed data, and points to the next most ideal ground for relevant data collection (Glaser 1978). Theoretical sensitivity informs theoretical sampling. Theoretical sampling asks: where next should I collect data from? Which group or subgroup? What time is the best for this collection? And for what theoretical purpose is this data being collected? Theoretical sampling allows the researcher to select and control their study cases, people, events, activities etc. through the evolving constructs of the research (Glesne 2011). Theoretical sensitivity and sampling continuously develop in intricacy and control to completely dehydrate the phenomenon under study from all irrelevant data and concepts.

Coding, comparative analysis, and theoretical sensitivity all work on daily basis, side by side along with memoing. If the objective of coding is to discover core categories and saturate them, the objective of memoing is to build the theoretical reasoning, description, and explanation of those core categories. Memoing is the process of writing notes (memos) as small as a couple of words or as large as several pages to capture the frontiers of the researchers' thinking as they go through coding and comparing (Glaser 1992). They can also include rough drawings of diagrams, tables, ideas, or even the physical space or participants of the empirical grounds. Memoing raises the level of observation and analysis from empirical practical grounds to abstract generalised early versions and bits of hypotheses and theories. The 'frontiers' of the researcher's thinking is emphasised here: the preconscious ideation, sensing, or reason caught and recorded as it occurs in the mind of the researcher. Grammatical faults, spelling mistakes, and structured formats are irrelevant and must be overlooked when memoing so that the delicate developing idea being recorded isn't lost or forgotten (Glaser & Holton 2004). Memos are obviously private, subjective, and can rarely be comprehended by other than the researcher. This free style and flexibility also comes with the immunity of memos to being criticised or disproved of (Glaser 2013). Memoing happen all the time regardless if the researcher is on the empirical research grounds or outside of it; indeed, a researcher can be writing memos even when not studying because an important idea or thought can come to the researcher at any occasion or activity. Anytime the researcher drifts away with thoughts on the research to connect incidents, to explain what is described, to sense correlation, to determine where to search next, etc., it should be written down immediately in memos. Memos therefore, don't necessarily have to be on physical paper only. They could be a quick typing of notes on one's smart phone, desktop, or even a recorded voice message (Glaser 2013). What is important is that the researcher's idea is captured in the moment. Memos are not just generated from the constant comparative method; any form of investigation for the research can generate memos: literature reviewing, interview transcripts, writing a study paper, discussing with colleagues, random thoughts, and even earlier memos (Glaser 1995). The disorder with which memos are being generated and recorded by rules and conditions of any idea, anytime, anywhere, and in any form gets ultimately arranged and organised in the last step of grounded theory called 'sorting'. Sorting therefore aims to arrange concepts and ideas abstracted from data, but not the data itself (Glaser & Holton 2004). Sorting usually happens towards the end of theoretical coding. Nonetheless, it can start anytime from the end of selective coding when core categories are saturated, to the beginning of thesis write up. According to the force of the depth and quantity of the emerging categories, properties, and ideas, it will compel its beginning, middle, and end (Glaser & Holton 2004). The researcher carefully re-reviews all memos, core-categories, categories, and properties, and arranges and assimilates them into their orderings and patterns, which in turn amalgamate into the complete model or framework of the theory. The rich multivariate heavy theory emerges with sorting not just because of the visual connection made between memo thoughts and categories properties, but also because sorting generates more memos. This final stage of memoing is usually highly theoretical, focused, and connects all concepts into one mesh of results (Glaser 2002). That's why sorting and write-up usually go hand in hand. When sorting, researcher also tend to move forward and backward in time of the collected data to see how the core categories (as emerged by coding and explained by memoing) fit in previous or recent events, which in turn generates new thoughts for memos, which get sorted, signaling new ideas and data collection agendas, and prompting the researcher to go back to re-review the data through time in light of the new discovery (Glaser 2001). This loop enriches, defines, and solidifies theory while it's being written in concise, focused, and neat comprehensive paragraphs.

The machine metaphor of grounded theory reflects the best character of Glaserian grounded theory: its simplicity. The five machineries – coding, constant comparative method, theoretical sensitivity, memoing, and sorting – all run jointly in a systematic and efficient feedback mechanism. Should one machinery start running, all the rest follow in synchronization. They assimilate together in parts and function to make the one whole Glaserian GT. Just like any machine needs fuel to run, GGT depend on collected data. Glaserian GT allows for all techniques of data collection, whether they are interviewing, field noting, focus groups, or documentation; as long as they are methodical and systematic, and do not impose any external process of data manipulation for validation, accuracy, or authentication of data. For this research thesis, the data required for investigation are the practices concerned with knowledge exploitation. Since these practices are intrinsic to a project setting, participants are most likely to be only subconsciously aware of them. The research is carried out within a project setting and not on project management approaches and processes for this very reason. Conducting interviews or focus groups to recognise and identify the phenomenon would therefore be unfeasible or even inaccurate, simply because what is subconsciously known can't be effectively or efficiently elicited from recorded interviews. The ideal way to uncover and study such hidden processes is by directly observing them as they occur (Glesne 2011). The thesis study therefore deploys field noting as the method of data collection for the GGT methodology of data analysis. The following sections will now focus on field noting – its principles, rules and implementation.

Data Collection: Field Noting

There are two ontological realities in any field of research; the physical pre-existing natural one, concerning natural sciences; and the abstract artificial one, pertaining to social sciences (Latour 2012). Field noting can capture data from both realities of research – in controlled experimentations in laboratories, and in socio-cultural ethnographic settings. Field noting is therefore as old as are the first scientific or anthropological observations that were ever made. At first glance, field noting sounds as easy as the researcher writing down notes on a notepad about the phenomenon being observed. However, this simple practice raises many difficult and complex debates on methodology and methods, including: What exactly should be written about? What is the level of detail required? How to capture and record many observations at once? How to warrant researcher objectivity in such a subjective method? How to record a conversation in presence of participants engaging with the researcher? (Wolfinger 2002). Before going into the necessary depth to address these questions and others, it is important to review the concept being investigated in this research thesis and the different possibilities of the forms it takes as an observed phenomenon. Knowledge exploitation acts are socio-technological linguistic practices that develop and build on previously existing knowledge. This preexisting knowledge is neither indifferent nor static, it is actively guiding and directing the decisions made to bring about pre-established ideas of progress and change. Such knowledge evolving acts have no formal theory or definition in the project management literature, and are inherent and intrinsic to the project team members and other stakeholders as they occur across a project setting. They are therefore carried out subconsciously by human actors and technological artefacts. The easiest place to start with to observe knowledge evolving acts as they occur is noting any practices that stimulate action and learning. These may not necessarily be the knowledge evolving acts themselves, but it is a good place to begin.

The notes made on observations related to knowledge evolving acts on a notepad, physical or digital, are called field notes. Montgomery & Bailey (2007) elaborate carefully on the subject when defining field noting, and acknowledge that field notes have no formal definition. They argue that since field noting is principally and largely an anthropological research method, it is perhaps best to describe it from the perspective of an ethnographer. They cite Hammersley & Atkinson (2007), Roper & Shapira (2000), and Jackson (1990) among others, all ethnographers, to explain the meaning of field noting: the transformation of the mystique of the research setting by ideas and identifications made on the observed relations and interactions of individuals with the environment and each other, all saved for future reading in written communicative recordings. Similarly, Cunliffe (2010) cites the popular work of Van Maanen's (1988; 2011) *Tales of the Field* in contrast with John Shotter, Mike Agar, and Bud Goodall, (all renowned ethnographers) to give meaning to field noting, which conclusively amassed to no one explicit definition. Nonetheless, Cunliffe's personal opinions that highlight field noting are the characteristic thick descriptions and imaginations of the observations made of a phenomenon. Perhaps Glesne (2011) expresses it best when she borrows from Sunstein & Chiseri-Strater's (2002; 2011) simple yet clever way of understanding field noting: field study minus writing is just 'hanging out'. Writing field notes captures descriptive details of events, people, places, and interactions of that which is being observed; and reflexivity, pondering, ideation, and patterning of the researcher's ideas and actions while making the observations. There are many rules and conditions governing these writings; for example, jotted vs. expanded notes, chronological vs. contextual, descriptive vs explanatory, quoting vs. rephrasing, capturing 'pictures' or 'episodes', and writing vs. memorising. One can recognise a powerful aspect of field noting from these examples of a wide variety of choices on rules and conditions; it captures multiple channels of data sensing almost simultaneously – auditory, visual, kinesthetic, olfactory, and gustatory. Moreover, these senses are captured within contextual and symbolic chronological progression, spatial images, or interactive states. The researcher capturing the phenomena can choose to be either logical or intuitive in the mode of written description and analysis. The decisions to engage logic and intuition in field noting where the researcher thinks appropriately to the objectives and methodology of the research is reminiscent of theoretical sensitivity in grounded theory research.

It is worthwhile remembering that field noting initially started off as a way for researchers to keep their personal thoughts, ideas, and opinions along with private queries and other individual feelings on their research. These ‘scratch notes’ were not considered objective enough to be worthy of formal analysis. They merely reflected the researcher’s thinking process and served as memoirs or reminders. It was only later that field noting was considered a serious candidate for qualitative data collection and analysis when researchers started to follow specific principles and guidelines to writing research as put forth by renowned ethnographers and anthropologists such as Franz Boas and Bronisław Malinowski (Sanjek 1990). Field noting then expanded well beyond ethnography to become its own method of data collection and analysis across all types of qualitative research. Today, field noting is regarded as an essential constituent of qualitative research and encouraged to be employed, at least as a secondary function for thick description, analysis rigour, and a rich theoretical layering of the study, regardless of the other methodologies or methods employed (Phillippi & Lauderdale 2017). This research thesis takes up the particular field noting practice as advanced by Emerson, Fretz, & Shaw (2011) to be basis for doing field noting research. The various practices, suggestions, advice, and examples provided make this book a popular text on research methods for researchers interested in field noting. The book was originally intended to be a complete field noting strategy for ethnography, and so is bundled with ethnographic data analysis methodology. Although ethnography is a different methodology from grounded theory, there are a lot of similarities in the processes of analysis, such as coding levels, thematization, memoing, and reflexivity. Indeed, grounded theorists like Kathy Charmaz, Juliet Corbin, Anselm Strauss, and Barney Glaser are cited throughout the book. While these ethnographic analysis techniques may share with grounded theory many of the same definitions and practices, they are carried out somewhat differently. This empirical research therefore only implemented the chapters on field noting that are concerned with field noting as a whole integrative method of data collection. The following paragraphs discusses Emerson, Fretz, & Shaw (2011) as implemented.

The Observer/Writer & the Researcher/Employee

There is an ever-shifting momentum between the writer mode and observer mode in any field noting research setting. Investigators actively waiver amidst the two states in a manner that best captures the data and simultaneously prevents data capturing practices from missing or losing incidents that matter to the research. There is no rule on the writer/observer shift that enforces when the investigator should do what. It therefore ultimately depends on the researcher's intuitive sense and experience. This is particularly difficult for novice researchers who enter a field that is not their own. They must spend a considerable amount of time to gain the trust and familiarity of the participants by developing relationships and understanding the environment and the culture on which it functions. Fortunately, this study thesis takes the researcher into a field that he is already well acquainted with; a 'backyard' research (Glesne 2011). Nonetheless, bypassing the familiarising of oneself with new faces, environments, and practices happens at the expense of the researcher's attention being laden with preconceptions, pre-expectations, and existing social conformities. Furthermore, there is a certain sensation that influence researchers to stay within their comfort zones – residing with the people and places they are most comfortable with – at the expense of going 'far and wide' to explore. The researchers who know the participants in the field often become weary as their friends and colleague (now participants) change their social relations with the researcher being mindful that the researcher has stepped outside the role of a colleague by moving into the role of an investigator (Glesne 2011). Certainly, there are ways to overcome the anxiety of the participants and the pre-expectations or preconceptions of the researcher who is doing backyard research. They immediately depend on the research objective, social setting, and acquaintance levels, and the way the researcher employs these guides. For example, the particular researcher of this study thesis is aware that he has had other advantages and privileges that overcomes the anxiety of employee-turned-researcher with colleagues-turned-participants; the most important of which is that the researcher already does field noting as part of his job. The roles and responsibilities of the researcher as an employee in his field is to organise and run daily maintenance operations data and report this data on a daily, weekly and monthly basis. He has used field writing to record maintenance requests, responses, issues, contacts, possible solutions, items needed, and job statuses, among other such matters. The act of holding a notepad and jotting notes is no strange practice to the research participants that might otherwise have made them anxious or constantly aware and careful. The second advantage for this particular research study is that this is not the first time the company has participated in academic research. Previously it consented to several research studies being carried out by outside and inside investigators. One could even say that the company is ‘research experienced’. Management and staff are familiar with research behaviours and activities, and while some individuals act indifferently to it, others support it. A third advantage and possibly privilege is that the researcher is part of the project team that is heading the very project the research thesis concerns. The project itself requires that team members from various departments submit updates, keep various records, and review progress indicators; all of which necessitate frequent internal meetings and interviewing with external software vendors. The meetings and interviews that make valuable data channels for the thesis research are being supplied automatically for the sake of the project. Perhaps then, the only issue that remains with conducting this study thesis on empirically familiar grounds is the preconceptions and presumptions that might have taken hold due to the deficiencies of ‘initial impressions’. Emerson, Fretz, & Shaw (2011) suggest that besides being reflective and mindful of any presumptions, one can recall their initial impression, or observe newcomers, rare processes, and unusual developments, such as massive expansion projects, external assessments, or private corporate head visits. Better yet, they advise that researcher 'immersion' is not researcher 'merging' with study fields. So long as the investigator maintains the commitment to and is reflective and aware of the researcher/employee balance, then the research's objective stance can be sustained without missing out on potentially valuable data.

Jottings & Extended Notes

As incidents transpire and develop in the scope of the senses of the researcher, it is vital that they are noted down there and then. This preserves accuracy and detail of the passing event better than recollection and noting at a later time. The challenge here then is the capturing as much as possible of the events while observing them instantaneously. For this activity, there are two approaches the researcher has used: head-notes and jottings. Head-notes are a combination of three or four words noted as a headline or a caption and might not necessarily be a coherent phrase or title. Head-notes progress from one instance to the other as bullet points in consecutive lines or full stops in the same line. Headnotes essentially focus the researcher's attention to observation more so than writing and rely on the researcher's ability to recall as much detail as possible while using as few words as possible. Emerson, Fretz, & Shaw (2011) recommend moving beyond simple head-notes to 'jottings' for an optimum balance between writing and observing. Jotting is neither an extensive written recording of incidents nor mere head-notes of it. They are basically brief sentence(s) consisting of key words and phrases that best describe the incidents. Jottings can be descriptions of visual, audible, and kinetic incidents in words, phrases, or even drawings. Experienced researchers can write more phrases and sentences filled with meanings that evoke memory and vivid incident recollection without losing focus on the incidents. The activity of jotting has two basic rules to consider before entering the empirical field. The first rule is that field notes do not have to be grammatically accurate. They can have spelling mistakes and syntax errors so long as they are comprehensible to the researcher and replete with meaning. Indeed, as observed by the researcher, natural dialogues of interacting participants can be full of grammatical mistakes, accent variations, pauses, interruptions, and over-talking; these, whenever possible, should be noted down exactly as they are. Incidents that transpire in the research field are likely to be lost if one is continually revising their grammar or spelling mistakes; not just as a case of missing observation, but also as a case of breaking eye contact during interactions with participants (Phillippi & Lauderdale 2017). Jottings therefore were written with the speed and efficiency that captures as much detail of the moment as possible at the expense of accuracy of language. The second rule is that jotting observations should be as descriptive as possible. Analytical jottings may be introduced on the side of the page or during the late stages of the research; depending on the methodology in use. Participant-observation, ethnography, and grounded theory all have different rules regarding analysing field notes. The Glaserian grounded theory adopted in this research initiates the researcher into four to five months of descriptive field jotting (along with analytical coding and memoing) before phasing into a mode of descriptive/analytical field jotting. While field jotting is often done in longhand, it is recommended that extended noting be typed on a word-processing program (Emerson, Fretz, & Shaw 2011). Extended noting is, as the name suggests, the expansion of the jottings written during the researcher's presence in the empirical field. Extended noting is exercised when the researcher goes back to his/her desk and away from the research field – in preferably a maximum of three to four hourly episodes – to expand on, develop, and widen the ‘raw’ field jottings into deeper more detailed field notes by relying primarily on memory. The researcher writes up the jottings in haste and in heavy pouring of all fresh thoughts and scenes from memory with no worry about consistency or appropriate phrasing. The goal is to get as much of the incidents recorded as possible in terms of expressive details and descriptive meanings, so long as they are fresh in experience. While expanding his field notes, the researcher was automatically engaged in preliminary analysis because he was reliving the incidents in writing them, and therefore could sense patterns emerging (Emerson, Fretz, & Shaw 2011). The researcher thus made sure to keep his memoing book next to him while he expand on incidents. There was a dilemma that the researcher faced every time he went on to expand raw notes: when to break expanding field notes for the sake of memoing, thereby breaking his memory chain and losing some details, and when to sacrifice memoing new emerging thoughts for the sake of continuing the memory chain for more and deeper details. Luckily, GGT provided guidance on how to deal with this puzzle; the researcher focused more on data collection than analysis in the beginning, and phases into a focus on data analysis over data collection as the empirical research progressed towards the finish line (Glaser & Holton 2004). This means that at the beginning, the researcher leaned more towards sacrificing memoing for the sake of field note extension, and nearer to the end compromised on making extensions to existing field notes over engaging in more prolific memoing.

Recollecting & Depicting Strategies

When the researcher sits down at his/her desk to expand on raw notes, the mechanisms that play a role in recollection are the symbolic jottings and the biological memory. Expanded notes – while incoherent or ‘loud’ with meanings – tend to be written out in organised sequences of recollection.

There are two strategies for recollecting from jottings and memory to write in organised structures; chronological recollection and significance recollection. Chronological order is the expansion of jottings in the order of their incidental occurrences over time. The dramatics involved are noticeably developing before reaching climax and resolution. This strategy assists the researcher's mind to concentrate on relating between causes and effects or sequences of action between all incidents without prejudgments while expanding the raw notes. Significance recollection, in contrast, is the expansion of incidents that stand out as the highlights of the day, are particularly vivid, or are important to the area of the research, before expanding on other jottings. This strategy assists the researcher's mind to focus more carefully and insightfully on recalling incidents that are core or immediate to the research topic by concentrating on expansions that matter, and overlooking the incidents that are supplementary or irrelevant to later expansion. Emerson, Fretz, & Shaw (2011) advise that there is no harm in alternating between the two strategies of recollection while expanding raw notes. Between the chronological and the significance expansion for recollection, the researcher followed the chronological recollection at the beginning, middle, and early part of the final stages of the research, and shifted to the significance recollection towards the end of the research. This is because chronological recollection strikes more immediately with open coding in the sense that it offers chances to all incidents that may potentially be noteworthy for the research objectives. Significance recollection, in comparison, strikes more immediately with selective and theoretical coding, because it assists the researcher to focus on remembering those incidents that are already diverging into categories or core categories of the research objectives. Both chronological and significance recollections can be aided by the depicting strategies of the raw jottings. There are two basic depicting strategies that Emerson, Fretz, & Shaw (2011) discuss; sketches and episodes. Sketches are the depictions of a 'snapshot' of a setting, a character, a scene, or a situation. It is a picture frozen in time that describes the context to orient the actions and consequences that are about to unfold. Sketches are not limited to sense descriptions either, and they may also depict the context kinesthetically. The sketch paragraph created by chronological or significance recollection is a still scene that sets the 'calibration' or point of reference from which the researcher can draw the sequence of action to relate one incident to the other. Depiction of the action or sequence of events as they unfold in time and space are in paragraphs called episodes. Episodes describe processes, interactions, procedures, consequences, or effects as they change, progress, and reveal themselves between spaces, times, and individuals. Episode paragraphs created by chronological or significance recollection can meet multiple sketches bringing branching effects and consequences. Since knowledge evolving acts can be better realised and understood by observing them unfold as events rather than observing them as frozen pictures, the researcher deployed episode depictions more than sketch depictions in field noting.

Point of View Narrations

Field noting does not merely capture descriptions from the surrounding reality, it captures descriptions from a very particular angle by which the researcher is viewing the target reality. The position and voice of researchers documenting their inquiries and explorations in field notes inevitably appear in their writings. Therefore, addressing one's perspective on reality and following a specific writing technique to best reflect that perspective is as essential matter in field noting; different points of view tell different stories. A point of view in field noting is the writing technique that best reflects the narrator's (researcher's) philosophical stance. While there are a variety of techniques available for adopting points of view for a narrator to apply in field noting, the long-standing distinctions about voice are the main ways they branch off into three separate styles: first-person, third person, and omniscient narrator perspectives (Emerson, Fretz, & Shaw 2011). Writing in the first-person point of view (POV) is characterised by the insertion of the narrator's thoughts, feelings, and experiences with the occurring incidents. It must be noted that while such experiences transparently border on the analytical senses of the researcher more so than do the descriptive ones, the narrator's accounts of his/her experiences are different from the narrator's analysis of his/her experiences. First person POV is recounted in the mode of "I"; a focus on the researcher over all other participants. One of the finest benefits of first person POV is that it allows the researcher to associate or invoke previous experiences reflexively that occurred long before the research, along with incidents from the research itself. The third-person POV relieves the researcher of his/her body to scan the surrounding context like a hovering drone. The researcher himself/herself is referred to as "s/he, their, them". The third-person POV narrators often obscure their presence in their writing or even completely abstain from making themselves present in field notes. The omniscient POV is a writing POV where the narrator/researcher communicates the impression that he or she knows everything there is to know about the research participants, settings, and context, and has unlimited access and movement capabilities across data, incidents, and individuals. The omniscient POV writing style is a perspective and tone of narrative voice that merges all incidents and interactions taking place in the empirical field into one objective confident all-knowing voice. With all this knowledge and privilege, the researcher becomes almost a deity with the power of seeing and knowing everything, hence the name 'omniscient POV'. Since the omniscient POV often ignores or overlooks other perspectives that might be of importance, Emerson, Fretz, & Shaw (2011) advise against using it. As noted earlier, the three basic POVs – first-person, third-person, and omniscient – branch out into more varieties of POVs. For example, a third person POV can become a ‘focused third-person POV’, which is a writing strategy that concentrates on one particular participant who is considered to be of particular interest to the research. The researcher deployed a ‘shifting POV’, alternating between first and third person POVs (Emerson, Fretz, & Shaw 2011). This was not always the plan for this research study; initially, the researcher considered the omniscient POV to be the most effective because of its intense detachment from the socio-cultural relations and structures. The idea was that since what is being studied are knowledge evolving acts, which are learning habits and practices, and not social or cultural relations and interaction related to knowing and knowledge management, the omniscient POV provided a perfect writing style to adopt. However, the researcher soon realised that he neither has unlimited access nor absolute freedom of movement across the empirical research ground, nor the bottomless knowledge of the research participants and the project setting. The challenges in writing a first-person third-person shift POV is similar to that of alternating between the employee and the researcher personas respectively. So long as the researcher is reflexive and intentional in shifting POVs, this writing style can embody the philosophical perspective of a pragmatist in written descriptions. Furthermore, the researcher can write in a distant and detached manner even during the first-person POV shift by describing events in an objective and impersonal tone (Emerson, Fretz, & Shaw 2011). This perhaps makes for a better pragmatist perspective in field noting.

Perspectives of Experience

An incident can be written down as it happens – in ‘real-time’, or after it has happened – at ‘end-point’ (Emerson, Fretz, & Shaw 2011). Writing incidents in real-time means that knowledge about the field is partial or incomplete. Narrators tell about an event that they do not know much about since it is as yet unfolding. Real-time field noting offers the researcher an experience of accounting for individuals, processes, interactions, and events coming together while not knowing how this incident concludes thereby giving the research notes an aura of mystery, confusion, or optimism. The ambiguity associated with real-time field noting slowly diminishes as the researcher becomes more familiar with the participants and their habits, and aware of the recurring patterns. In fact, the researcher would sometimes go back in his field notes when he/she fully realises the knowledge behind his observations to note in what ways his description and understanding, now complete, previously was more partial and fragmented. This process is called ‘retrospective reinterpretation’, and is a very useful method for memoing in grounded theory and for data analysis in general. In contrast, end-point noting offers the researcher an experience of accounting for incidents that he/she fully knows about, since it has already completely unfolded. The researcher describing completed incidents does so with better confidence, higher definition, and certainty about his/her descriptive noting and consequently writes with greater confidence in his/her analysis. Nonetheless, unlike real-time field noting, end-point field noting might very well miss key interactional connections between incidents that may be potential patterns. Furthermore, crucial yet obscure happenings may get overlooked or forgotten since the researcher is describing a scene that has already taken place. Choosing between the two experience perspectives (real-time and end-point) was up to the researcher’s judgment in seeking to achieve a best case scenario. This decision was taken impromptu rather than prepared beforehand, except for those incidents when the researcher was aware of a future incident that will take place later. In terms of GGT, real-time and end-point narration experiences are part of the decision-making skills of theoretical sensitivity and theoretical sampling of the researcher.

Data Analysis

The researcher knew from the beginning that using a qualitative data analysis software such as NVivo might compromise the delicate cycle of theoretical sensitivity and theoretical sampling. Since this is his first experience with conducting grounded theory research, the researcher's sensing and intuition strikes better when he is directly involved with the physical and mechanical processes of coding, sorting, memoing, categorising, and organising rather than delegating them to a qualitative analysis software. The first step before going into the empirical field was therefore to design a data analysis sheet from scratch which will first serve to centralise all the different analysis processes involved in Glaserian grounded theory, and second as part of the complete empirical research record for reference. Grounded theory analysis starts in part two of the record, and qualitative document analysis starts in part three of the record. Part one gives the reader a brief orientation and background to the record. Every time there is a shift in the analysis method within part one, two, or three (for example from substantive coding to theoretical coding or from grounded theory to document analysis), a guide box appears detailing the objective, practice, and process of carrying out the new analysis method. These boxes don't only guide the researcher, but also serve as a track of progress.

Data analysis and data collection in Glaserian grounded theory are not two separate research phases, they are maneuvered simultaneously in a sound logic of the researcher; this is referred to as theoretical sensitivity. Data obtained for field noting was analysed in a manner that informed the next process to obtain further data; this is referred to as theoretical sampling. During the working hours of the day, data was being recorded longhand in jottings on a notepad and as soon as possible, expanded into filed notes on a computer desktop. After the work hours of everyday, the researcher conducts coding and comparative analysis of the recorded incidents to produce memos and categories which carry the insight required for a feedback theoretical sensitivity and a feedback theoretical sampling. Within this spiral of data collection and data analysis, codes of incidents and categories were formulated by using substantive coding in the beginning, then theoretical coding when the core variables emerged.

In a research-practical sense, to code is to give a title to every line (line-by-line coding) or every sentence. The code itself can be anywhere between a couple of words and a sentence. Coding has different rules at different stages. At the beginning of a grounded theory research, coding follows the rules of 'substantive coding'; a coding process that explains the situation empirically. Substantive coding is further divided into two phases: open coding and selective coding. Open coding allows the researcher to stay in an explorative mode by describing the incident as literally as he/she can. At this stage the researcher will code in every way possible so that he is liberated to studying his objective from different angles, thereby giving the researcher the possibility to generate more than one code for every line. Selective coding is the next stage when the researcher starts to focus on specific categories at the expense of the irrelevant others. At this stage, the coding starts to become more conceptual and abstract. What will emerge next is the core category. Core categories are then furthered by theoretical coding; a highly generalised and conceptual technique of coding. Throughout coding, the researcher was mindful of the different types of reproduced dialogues in the field notes – direct, indirect, and reported speech – and had to take the best decision between coding them in vivo or in vitro (Emerson, Fretz & Shaw 2011). The difference between reproducing dialogues directly, indirectly, and reported is basically in the varying degrees of paraphrasing. Directly reproduced dialogues is in quotations and is the word by word utterance of the interaction. Indirect dialogue reproduction is the approximation of what is being said and has no quotations. Reported speech is the indirect reproduction of dialogue interspersed with quotations of the exactly uttered words. In grounded theory, besides giving a title to each dialogue sentence, there are two other ways one can code a conversation: 'in vivo' (from life) and 'in vitro' (from glass). In vivo codes are those that replicate the exact words being said, but are presented as a code rather than data. In vitro codes are those constructed by the researcher to reflect the data (Elliott & Higgins 2012).

The grounded theory analysis in part two of the empirical research record is designed to complement the coding and comparative analysis operations. It is divided into three time periods: stage one substantive coding (first open then selective), stage two theoretical coding, and stage three sorting. In the evening after the day's work, the expanded field notes are first divided into incidents (denoted as 'I') each given their own unique number for reference (for example 'I#12' is a reference to incident number 12). The expanded notes were already divided into field note sections (for example F#12 is a reference to field note 12) and ordered in time. After the expanded field notes get divided into incidents, the researcher begins the coding process. The same table that horizontally contains the incident number and the incident also has blank fields for open coding (denoted OC#) and selective coding (denoted SC#):

#	**INCIDENT (I#)**	**OPEN CODE (OC#)**	**SELECTIVE CODE (SC#)**
1	My professional email address (a domain from Etisalat servers) has reached its full quota. No emails can be received or sent.	*Work email max capacity reached	

The reason why selective coding is given blank fields much earlier than its due time is so that the researcher can *phase in* between coding stages rather than suddenly break and jump. For a smooth phasing in, once selective coding started, open coding did not stop. Similarly, when theoretical coding started, selective coding did not stop. Phasing in of the different coding stages helps the researcher with a smooth transition when transforming from practical to higher level abstractions. This also ensures a solid stem of accuracy and precision between data grounded and prospering theory when comparative analysis process is underway:

#	INCIDENT (I#)	OPEN CODE (OC#)	SELECTIVE CODE (SC#)
1503	I note that there are quite a lot of similarities in the de Jure tech specs sheet with the items I have recorded. I think I can fit the data into it, but it wouldn't be complete.	*noting similarities: de jure list vs. recorded list *can fit recorded items in de jure list but won't be complete *implying: data can be fit into each other	*let de jure list define base knowledge structure

#	INCIDENT (I#)	SELECTIVE CODE (SC#)	THEORETICAL CODE (TC#) (core categories)
1735	Many a times someone doesn't fully understand a point and so has to be explained again (either by the same person or by a different person).	*many involved = collective discussion *points repeated	Discussion Redundancy

Comparative analysis is exercised both during and after the coding process of the day. The researcher would have a set of papers or a note pad ready along with the computer, and would be doing coding on the computer screen and comparative analysis on the note pad simultaneously. After coding is complete, the researcher would go several times back through the codes and the comparison sheets first to look for anything he might have missed, and second to strengthen the comparing process with certainty and conviction. In the beginning the researcher was at a sense of disorientation and incoordination due to the highly explorative nature of Glaserian grounded theory specifically during the open coding stage. As the days and months rolled and open coding turned into selective coding, the researcher gradually regained that sense of control and direction of the empirical investigation. Finally, between end selective coding and beginning theoretical coding, the researcher reached a point where he could mentally code and analyse an incident as it occurred.

Along with the everyday task of field noting, coding, and comparative analysis, meoming is central to theoretical analysis, sensitivity, and sampling of grounded theory. Memoing did not have the ordered allotted time slots that the other grounded theory operations had every day. Memoing happened anytime, anywhere, and on any sheet or device the researcher could get his hands on. Memos written were not arranged into any order too; memo writing has no restrictions on what preceding or subsequent memos are supposed to be. Memos often jumped from one idea to the next, and from one task to the next without a necessary continuity. One memo can contain more than one idea, and can be used for supporting, amending, negating, building, relating, or identifying concepts as distance is being put between reality and abstraction. Memos were generated by self-negotiating comparisons and comparison, literature review, field notes, random thoughts, earlier memos, and sudden eureka moments. The arbitrary and often impulsive nature of memoing in grounded theory has earned it the name 'freestyle memoing' (Glaser 2013). Memoing, among all grounded theory processes, has had the maximum impact and sense of free exploration of incidents, ideas, and concepts on the researcher:

Memo sorted in 'GAP'	Throughout its phases, PM requires a constant organization and re-organization of knowledge (RPM) TICK!. All knowledge (plans, designs, executions, uncertainties, mitigations, action plans, activities, assignments, timelines, budgets) is set and fully specified in advance of delivery (CPM) NO TICK!

Memo sorted in 'INSCRIPTION'	I just realized that the sticky notes on files were meant as an updating notes, updating on whats missing and whats available. Once updates are complete and these notes have done their job, they are torn away and thrown into the garbage
Memo sorted in 'REDUNDANCY'	AR is telling me that its natural to face a lot of delays, specially with such a project. He told me that delays happen for many reasons. Things always keep coming up in a project. It was very surprising to me when he suggested that we could take advantage of these delays and use the time. he said we could re-arrange things, collect more information, or become more familiar with the project process. This is interesting as I have never seen anybody who looks positively at project delays.

Once saturation was reached at the end of selective coding, an excel sheet was built to document the complete elements of theory. The sheet contained three levels that describe core categories as they transform from actual to abstract: core categories, their categories, and their categories' properties. At this point, Glaser (1978) offers 18 coding families that one may use at the theoretical coding stage when core categories have emerged. Since the knowing acts – the core categories of the research – are carried out simultaneously and spontaneously rather than sequentially and consecutively, the coding family they were fortified to was the 'Strategy' family instead of the 'Process' family (Glaser 1978). During theoretical coding, this sheet helped in keeping the focus on interpreting relevant incidents as part of the core categories to further their substantiation. When theoretical coding came to an end and the core categories fully saturated, the next (and final) step was sorting. Another excel sheet was built and was first divided into the four core categories – *inscription, technological extension, discussion,* and *redundancy*; each category assembling the now arranged relevant memos. The excel sheet was then divided to include other categories where the rest of the memos could be assembled under: *gap, knowing acts, research methods, further research and limitations,* and *miscellaneous*. Both the elements of theory excel sheet and the sorting excel sheet served as the theoretical insight necessary to the writing material of this doctoral thesis. As implied, these insights were not limited to the core categories, they also contained ideas and thoughts related to gap in literature, research matters, limitations of study, and random uncategorised considerations.

By the end of the Glaserian grounded theory research, 410 field notes covering 1970 incidents within 3 project phases (definition & initiation, selection & planning, and pre-implementation) produced a total of 50,049 words that circulated the feedback loop of collection and analysis. Grounded theory research started on 8/May/2016 and concluded on 18/Oct/2016, covering a time period of 5 months and 10 days. Figure (3.2) summarises the whole of the primary research methodology. The researcher took the following two months, November and December of 2016, to relay the results (the knowledge evolving acts) with the philosophical, theoretical, and practical orientation of the knowledge-evolving project mostly by doing literature review. Towards the end of December, the researcher decided to triangulate the saturated results by implementing qualitative document analysis research. The next section will describe the data collection and analysis processes the research has undergone during qualitative document analysis.

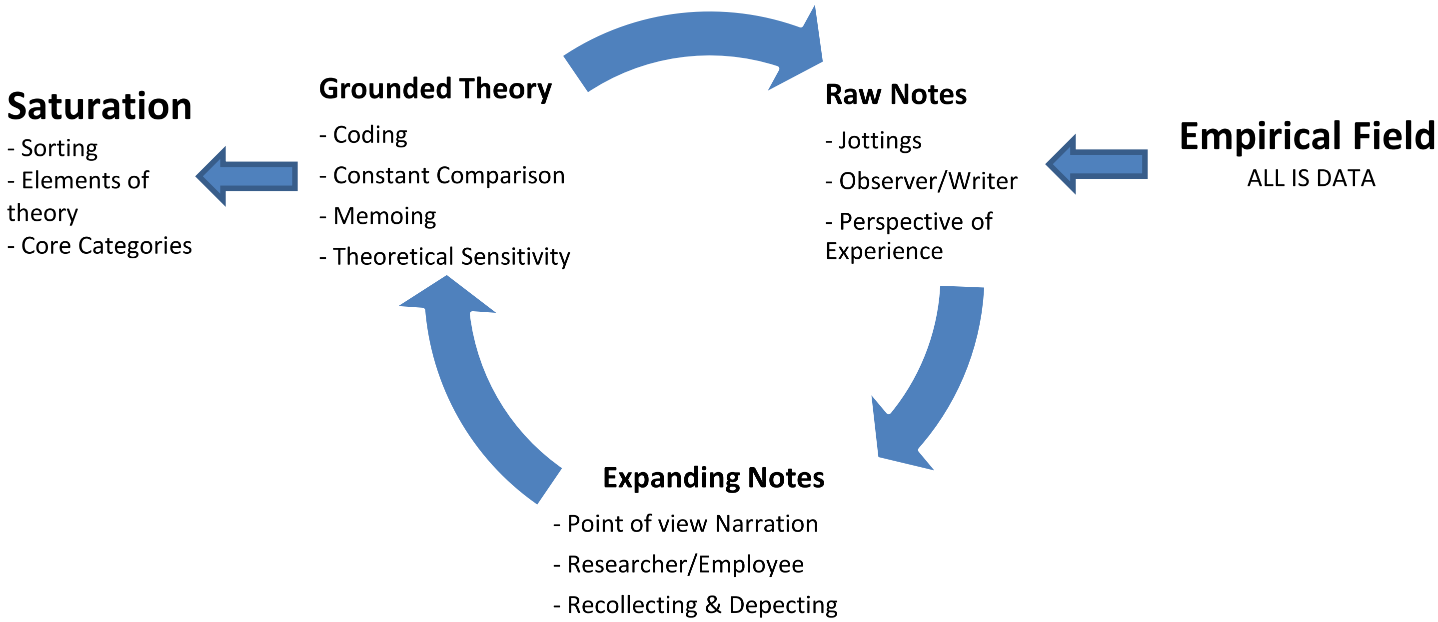

Figure 3.2: Implementation of the primary research methodology and method

3.6 Secondary Research Methodology: Qualitative Document Analysis

Document analysis in books on research methods is usually explained as a complementary or a completing research process rather than a separate whole (e.g. Creswell & Poth 2017; Silverman 2016; Marshall & Rossman 2016; Flick 2015; Bernard & Bernard 2012; and Glesne 2011). Indeed, one will find that searching through scholarly publications for document analysis as a whole and inclusive social science research methodology in its own right is not an easy task. There are only a few studies that demonstrate how one can assimilate document analysis/document collection into a complete separate methodology to be used as a standalone legitimate and authentic scholarly investigation. It is not clear why this is so since document collection and analysis has been an influential and popular method for qualitative studies for longer than have interviews and surveys in the humanities subjects. The abstract of Bowmen's (2009) highly cited paper *Document Analysis as a Qualitative Research Method* states that the article is targeted towards research novices. Could it be that over the course of many years of research document collection, the process of document analysis comes naturally to the experienced researcher without any need for explicit codified standards and guidance on research design, methods and applications? This suspicion is justified in the opening paragraph of the same paper where Bowmen (2009) expresses doubt on the soundness and rigour of more experienced researchers who have used document collection/analysis without providing sufficient details on the procedures and processes followed and implemented in their research studies. Either way, it is important to explicitly define and demonstrate the particular systematic methodology of data collection/data analysis before implementing it in the empirical setting.

This research thesis adopts qualitative document analysis; a systematic document collection / document analysis methodology frequently used for political and media scholarly research (Altheide & Schneider 2012). Qualitative document analysis invites the researcher to collect specific documents relevant to the research topic and interpret them systematically and methodically (Bowmen 2009). Qualitative document analysis incorporates more than just content analysis and thematic analysis; it also draws the attention of the research to investigate the connections of the documents with the real world; its authors, objectives, consequences, and even storage means (physically or electronically) (Altheide & Schneider 2012). Different document types express various records differently as data for investigation and study. O'Leary (2014) observes three main types of documents: (i) public records – official organisation documents filed in physical cabinets or digital folders including annual reports, policy guides, operation manuals, employee portfolios, and strategic and mission plans and statements; (ii) personal documents –

accounts written out by individuals that tracks a progress of work including email communication chains, duty log books, personal blogs, calendar reminders, and scrap notes; and (iii) physical evidence – physical artifacts found on the study site and their symbolic meaning and expression such as murals, posters, flyers, logos, photographs, and bulletin boards. O'Leary (2014) also provides the researcher with an 8 step document analysis process similar to that of Altheide's (1996) but with particular attention to 'managerial' measures such as making copies for annotations and developing an organisation and management scheme for the documents. Atheide (1996)'s steps are more 'analyser' oriented and divides document analysis into 6 consecutive steps: (1) setting inclusion criteria for documents as per the research objectives and aims; (2) collecting the different types of documents from various sources; (3) articulating key areas of analysis in terms of categories, properties, hypotheses, frameworks, or direct real life incidents; (4) code and investigate documents into addressed themes identified in step (3) thereby enriching them with deeper meaning, context and relevance; (5) verify the analysis process; and (6) observe and analyse the bigger picture of the now investigated and thematized documents by comparing them with each other and recounting how they assimilate to address the research objectives. The researcher would like to think of O'Leary's (2014) division of document types as the 'document analysis in space' and Altheide's (1996) 6 steps of processing document for analysis as 'document analysis in time'.

Before absorbing qualitative document analysis as a secondary methodology into this research thesis it is important to consider its capabilities and limitations and reflect on implementing it as a methodological triangulation strategy. Bowen (2009) lists several factors to keep in mind when examining the advantages and control borders of document analysis. The first and most appealing aspect of qualitative document analysis is that documents as data are more readily present than interviews or surveys that require respondents for completion. Document collection therefore is merely document selection; it doesn't require respondents to complete them. Furthermore, once the researcher attains clearance to access the required documents, they are made easily available and uncomplicated to search for in the public domain or public records of the organisation. Thus, the time and cost associated with designing, distributing, and collecting surveys or interviews to obtain data is irrelevant to data collection and analysis. Another major aspect of document analysis is that they are 'non-reactive' and 'unobtrusive', meaning that they themselves as actants do not get affected by the research process, unlike for instance, interviewing or participant-observation which would affect how the incident being studied progresses. This could be either an advantage or a limitation depending on the research methodology, research objectives, and philosophical stance. Either way, the stability related to the 'non-reactive' and 'unobtrusive' characteristics of document research is an advantage to any study since documents can be reviewed and investigated as many times as the researcher likes, unlike real life respondents. On exactness and coverage, Yin (2013) observes that documents' inclusion of exact names, event details, and references, and its ability to cover long spans of time and broad range of settings makes it an ideal method for triangulation. A researcher can quickly review and analyse documents at face value just to verify and validate simple reference data such as events, individuals involved, date and time, and decisions reached. For a more rigorous and thorough triangulation and substantiation of the findings, the researcher should choose to apply document analysis as a complete data or methodology triangulation strategy. With all of these advantages and capabilities of the document analysis method one may be very tempted to take some level of it up (between a supplementary method and a full methodology) regardless of the primary methodology used. It is therefore important also to be aware of the limitations of document analysis and control borders. Yin's (2013) encouragement to use document analysis (especially in case studies) comes with a caution:

document research can run into retrievability trouble or worst yet, has an overall low retrievability rate. Sometimes target documents are lost, intentionally hidden, or the researcher is unable to find them; all assuming that the researcher did get permission for access. Such cases may drive the researcher into wasting unexpected energy and time as he/she tries to obtain the documents in question. Another concern that Yin (2013) raise is how the researcher selects the documents for study. The selection method should be impartial and objective rather than selective and discerning. One way to be objective in document collection is to collect as much data as possible on a specific incident, process, or policy regardless whether some of the collected document contents appear to be, for instance, only eighty percent irrelevant. Indeed, it is not easy to fully cover a particular event as document data because documents do not always provide enough data for the exact purpose of the research study (Bowen 2009).

Document Analysis as Triangulation

Most of these limitations are potential flaws rather than inherent disadvantages. Low retrievability is often an issue with the organisation or the researcher for some reason or another, and not a problem with the documents themselves being 'subtle'. Documents are, as mentioned, 'non-reactive' and 'unobtrusive'. Secondly, a biased selectivity of documents is the liability of the researcher not the documents. Making the necessary effort to be partial and unbiased in selecting documents is not difficult; there are guidelines and procedures to overcome this matter in almost all methodologies. Perhaps the only truly intrinsic limitation of document analysis is that organisational documents are created outside of the research agenda. An experienced researcher would be aware of this before entering the empirical research field and might even have a particular approach to address the problem. The advantage of the organisational context of the research setting chosen for this thesis, as was mentioned earlier, is the fact that the researcher is also an employee and a committee member of the project under investigation. Being so deeply involved on the inside gave the researcher the advantage of being already well-informed on the documents and knowledgeable about their contents. Consequently, the researcher already had a rough idea of the range of details covered in the targeted documents. Furthermore, the manner by which document analysis is being deployed here with the intention of triangulation rather than saturation means that the researcher has already reached a framework or a model that he can use to orient himself directly towards the gaps and missing details related to the research agenda in searching and analyzing the documents. To appreciate this position, one needs to first understand the difference between document analysis as triangulation and document analysis as saturation. In the opening of Bell's (2014) chapter on analysing documentary evidence, a distinction is made between the 'source oriented' approach and the 'problem-oriented' approach. The source oriented approach is one where the researcher allows the documents being collected and analysed to generate the queries and guide the direction of the research. It is akin to grounded theory research in the sense that it is inductive in nature. The source oriented research therefore is a kind of document analysis that systematically leads the researcher into exploration, identification, and saturation of data and results. The 'problem oriented' approach on the other hand is deductive in nature. It starts with specific queries, themes, and a well-recognized focus established by a separate methodology that was implemented earlier. The task of document analysis in this case is meant to validate, deepen, and substantiate the data and findings; in other words, triangulation. It is simple to see how document analysis as a 'problem-oriented' approach makes the issue of insufficient details from documents easier to tackle than document analysis as a 'source-oriented' approach. The researcher is mapping his/her analysis of document research into a predefined focus on the findings rather than searching far and wide to establish findings. It is therefore evident that the application of document analysis in this thesis is a ‘problem-oriented’ one with the objective of methodological triangulation.

Qualitative Document Analysis?

There is a reason why this thesis recognises its document research methodology as ‘qualitative document analysis’. A sharp reader would have realised by now that the fundamental (and indeed original) technique of any document study is content analysis (Elo et al. 2014; Riff, Lacy, & Fico 2014). For a quantitative researcher, recurring words, meanings, contexts, or tones among such other linguistic indicators in document research are innately objective within the text. Like minded researchers would then argue that content analysis will uncover the same evidence regardless of the researcher(s) or participants involved. Their method is often referred to as ‘document mining’; as in, mining the objectively embedded evidence in documents for later statistical analysis and modeling (Wesley 2014). Qualitative researchers on the other hand beg to differ. They acknowledge that the subjective involvement in content analysis – by a researcher or a participant – is what gives rise to meanings rather than the texts themselves. Evidence uncovered by a researcher is a result of merely one of the many possible readings. Researchers may very well uncover from the same texts different or even contradicting evidence (Wesley 2014) as is common in many of the debates between historians in studies of history. So why is this problematic? It is really a matter of reliability and validity of the data. Quantitative document analysts usually suffice with performing statistical operations such as Cronbach’s alpha and standard deviation to determine their reliability and precision. Qualitative document analysts differ and have more need to introduce additional empirical techniques to ensure validity and reliability such as the critical analysis of documents discussed earlier.

Although triangulation is favorably quantitative among research studies, this thesis deploys qualitative document analysis rather than the quantitative one for several reasons: (a) the saturated themes from the primary methodology – the knowledge evolving acts – are highly qualitative in character. Furthermore, knowing acts in the knowledge management context have not been subjected to quantification in the research literature. Transforming these practices to numerical indicators would have been purely based on the work of the researcher, which is relatively fragile in comparison to research work developed from well cited scholars; (b) this research study is exploratory in nature, which means that even the triangulation protocol should be implemented with a potential to make new discoveries. This possibility is considerably reduced if the secondary methodology was quantitative, especially because triangulation is intrinsically deductive; and (c) departing into quantitative methodology would disturb the harmony of the overall design of this empirical research study. The design, which has been the concern of this whole chapter, is built on levels of research families based on a pragmatist philosophical stance with the research tradition (qualitative) encompassing the research purpose (exploratory), the mode of inference (inductive), and the primary methodology (GGT) and method (field noting). Adopting quantitative document analysis would fracture the synergistic flow of the design. That disturbance does not occur when the secondary methodology is qualitative document analysis, where the overall research design is more likely to function harmoniously.

Document Analysis Tools & Techniques

Other than the text material or content itself, documents can indicate evidence from a wider range of angles. They can reveal the context and circumstances on which they are based, present the author's objectives and target audience, and point to particular tracking of events as the researcher progresses between one document to the next (Bowmen 2009). To facilitate the successful capturing of documentary evidence, document analysis methods incorporate well defined tools and techniques. The first technique to consider is the well-known and widely used content analysis methods. Content analysis can operate in two ways; by identifying and quantifying specific recurring words or phrases from documents, or by identifying, isolating, and studying the meanings of pertinent texts and passages (Hsieh & Shannon 2005). Content analysis for indication of frequency of particular wording or concepts is mostly a quantitative statistical research method and is often used in media and political studies (Riff, Lacy, & Fico 2014). The latter strategy of content analysis involves searching for those meanings behind the texts that produce or substantiates theories relevant to the study objectives. Both content analysis strategies can be approached in two ways; exploring the 'witting' evidence and the 'unwitting' evidence (Bell 2014; O'Leary 2014). Witting evidence is the data related to the information that the author of the document intends to communicate, and in contrast, unwitting evidence is the data extracted by learning everything else about the document. Content analysis overall is often considered as the 'first-pass' review of documents (O'Leary 2014; Bowen 2009).

The second technique to consider, also widely used, is thematic analysis of documents. Thematic analysis – as the name suggests – is the multiple (and often cyclical) reviewing and reading of documents in the hope to discern an emerging pattern to build categories and themes. The researcher exercises the familiar art of coding that starts from the substantive to the theoretical level (Bowen 2009; Hsieh & Shannon 2005). Predefined themes, categories, and codes can also be used to validate or verify patterns observed by another methodology. Whether the investigator exercises analysis of emerging or predefined themes depends on deploying document analysis for saturation or triangulation. Like any thematising analysis method, the research is expected to have a certain intuitive sense to make unplanned but sound judgments that steer the research closer towards the objectives. One can think of the relation between content and thematic analysis of documents as one between the younger and older sister. The metaphor here is meant to demonstrate the researcher's understanding and experience level of the document analysis at each stage.

The third technique to consider is the less familiar, critical analysis of documents. Critical analysis of document research is largely peripheral; i.e. it aims to investigate the external or internal context surrounding the making and storing of the documents. Critical document analysis examines the authenticity (truthfulness and originality), legitimacy (approved or authorised for storage and circulation), and even procedures of documentation in an organisation from a critical perspective (Bell 2014). It motivates the researcher to ask questions like: Who is the author(s)? Who else participated in producing the document? Whom are these documents addressing? What kind of document is it? What were the circumstances under which those documents were produced? Is the information presented in the document consistent with the real life facts? What is the clearance level for accessing the document? Why? What is the status of the document (in-progress or complete)? What other purposes does the document serve? What format is it available in (soft or hard copy)? How does one document relate to the other? (Bowen 2009). Critical analysis of documents has a lot in common with discourse analysis, especially in the ideology of the social construction of knowledge, hence many of its research tactics and techniques are derived from discourse analysis (Sapsford & Jupp 2006).

Data collection and Analysis

As previously discussed, qualitative document analysis was favored over quantitative document analysis mainly because the knowledge evolving acts are highly qualitative in nature; which means that the context and narrative behind the contents of the documents can reveal more than the contents of the documents themselves about the knowledge evolving acts. Since qualitative document analysis was meant to be a triangulation research method, the saturated core categories from grounded theory research were the predefined focus of the data analysis processes, effectively making this qualitative document analysis a deductive one. The three techniques of analysis applied on each of the 91 collected documents were content analysis, thematic analysis, and critical analysis (not necessarily in that order). The task for choosing the pertinent documents for this empirical research was an easy one since the researcher – being an employee and a member of the project committee – is well informed of the documents and knowledgeable of their contents.

Most of the hardcopy documents that contributed to this research were photocopies of the original. This is so that any odds of damage, mix-up, or loss of the documents are minimised. The researcher may go back to the originals anytime he wishes to, but is not allowed to take them home. Two tabulated excel sheets were constructed to carry out the analysis. The first excel sheet labelled 'document collection' served as the station for critical document analysis, and the second labeled 'document analysis' served as the station for content and thematic document analyses. 'Document collection' numbered documents collected in order of date of availability (oldest to newest), and 'document analysis' ordered documents in terms of the core categories they belong to.

‘Document collection’ tab included the background contextual details of each document: its status (complete or incomplete), type (proposal, schedule, communication etc.), availability (softcopy or hardcopy), authors, purpose, and target audience. It also contained the different versions of documents as they evolved through the project lifetime. The ‘document collection’ tab records the documents’ complete life stories and presents them in an overall big picture for the researcher’s reference:

#	Document	Status	Type	Access	Author (s)	Purpose
15	SSP9 Email chain -1		communication	softcopy	HPR, HN, Ghassan	discussing SSP9 system
16	SSP9 System leaflet		powerpoint	softcopy	SSP9	introducing company & all available systems
17	Sample sheets - equipment management	incomplete	spread sheets	softcopy	internet (edited)	creating equipment management sheet for XAX

The ‘document analysis’ tab captured the way each document informs the core-category. For every core-category, the content and context of the documents were analysed, and recorded. The record ‘documents selected’ presents the documents studied, and the record ‘data analysed’ present the way by which they were studied and how that informs, substantiates, and validates a particular core category:

Core Category	Document(s) selected	Data Analysed
Redundancy	D1, D17	Both D1 and D17 were collections of spreadsheets from outside sources meant to be used to create an equipment management spread sheet for maintenance items. Both D1 & D17 sheets were worked on seperately and unsuccessfully. Eventually they led to the successful creation of the items list in store.
	D66, D68, D73	Maintenance job flows for the new system were first planned by HN alone in two versions. Then another separate version was created by AR and Ghassan. However, all versions were studied to create a new job flow. This was included inside D74.

On many occasions the researcher would go back to the author(s) or look for support from his colleagues to confirm or settle some information about the documents. Qualitative document analysis ran for a period of 1 month and 20 days (from 2/Jan/2017 to 21/Feb/2017) before fully triangulating the saturated core-categories. The core categories – inscription, redundancy, technological extension, and discussion – are the final and ultimate results of the empirical research. Figure (3.3) below summarises the implementation of qualitative document analysis and document collection.

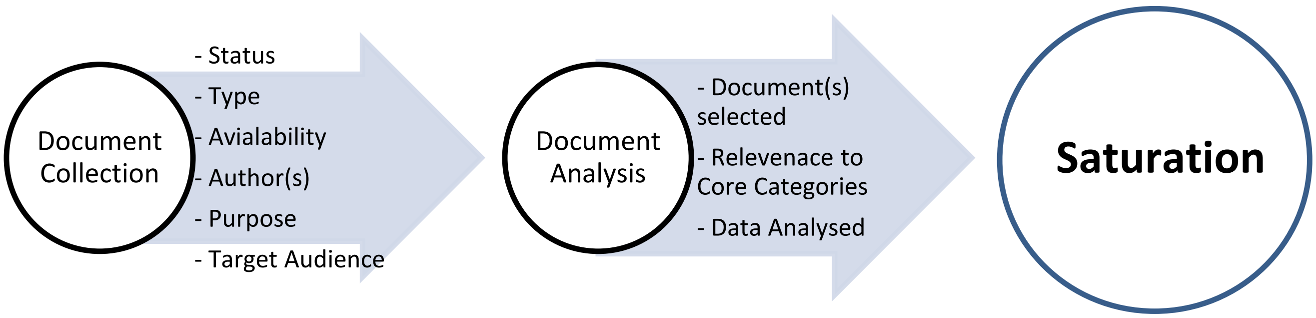

Figure 3.3: Implementation of the secondary research methodology and method

Summary

This chapter, in its entirety, has described the processes, tools, and techniques of the design and implementation of the empirical research. Drawing from the research questions, specific aims, and objectives, the levels of the research design and methodology were built one by one top-down: from the research paradigm, research tradition, research purpose, and mode of inference, to the primary and secondary methodologies and methods. The rules and techniques of the research design were followed credulously and curiously in the implementation phase to attain the findings. The next chapter will reveal the findings and how they were reached.

CHAPTER FOUR: RESULTS

4.1 Research Context

The United Arab Emirates enjoys a global reputation as an economic hub and an excellent location for investment. It is full of miraculous projects: record breaking sky scrapers and high risers, massive shopping malls, 8 lanes intersecting highways, and artificial islands. In 2014, UAE won the bid to host Expo 2020; an international exhibition overseen by a global intergovernmental organisation based in Paris. Since then, mega projects such as museum of the future, Dubai water canal, Abu Dhabi Masdar City, and Sharjah Sir Bu Nair Island are set for completion in 2020 targeting the already blooming tourism and aviation industries. The workforce of UAE is highly diverse in terms of cultural and societal backgrounds with some 80 percent foreigners from 100 different countries. Unlike the other highly developed economic countries, UAE was built to its vast metropolitan state in 30 years or less. This opportunity presents UAE as a perfect site for conducting this doctoral research – the variety of projects, the diversity of employees, and the metropolitan geographic and demographic state supports the high level of generalisation of theory that the researcher aims to reach.

The organisation upon which the empirical research was conducted is reflective of the fast paced, professional, and business oriented spirit of the UAE. Spread across 4 cities, the organisation – heron referred to anonymously as ‘COG’ – runs a group of companies of various industries including real estate, jewelry, shopping centers, and financial services. It employees more than a hundred workers from different countries and backgrounds, and is mostly structured as head divisions per city. The company chosen for this doctoral research is the head of the Sharjah businesses, and is itself a real estate building for offices, commercial units, and residential flats.

The building has a two-floor shopping mall, a hospital, a major commercial health club, and a hotel block. The company is also the head office for three other buildings in Sharjah that are mostly residential. The managing director has requested that the company and the participants not be named. The participants are given pseudonym initials and the company is referred to ‘XAX’ throughout the empirical investigation records (see appendix). Third party vendors, their companies, and systems are also given pseudonyms

The subject of the empirical research is the digitisation of maintenance operations which functions as part of the Operations Department headed by the operations manager *AR*. The ‘Digitisation Project’ was initiated by the managing director *MZ* with a short-term goal of digitising maintenance operations of XAX and a long term goal of integrating the currently running system – code named ‘Clerk’ – of the Financial and Leasing departments. During project initiation and planning, the constraints swayed between a full digitisation of all operations and a partial digitisation of only the maintenance operations on one hand; and between digitising maintenance operations of XAX only and centralising maintenance activities of all the group of companies under one system on the other (Table 4.1).

	Maintenance only	**Full Operations Department**
Sharjah Company	XAX computerised maintenance management system (CMMS)	XAX computerised facilities management system (CFMS)
All the companies group	COG computerised maintenance management system (CMMS)	

Table 4.1: The Digitisation Project's oscillating constraints

The researcher himself is a central participator in implementing the project since he is the maintenance engineer in XAX. Along with the operations manager *AR*, managing director *MZ*, financial manager *GPL*, and project coordinator *HN*; the managing director of the Dubai office *AZZ* was an active catalyst to the project since he was pushing for the new system to extend to Dubai office. However, as clearly evident by the number of times her name appeared in the recorded empirical notes, *HN* was the most involved in spearheading the project. In Glaserian grounded theory, the designed sample size and involvement of research participants and settings are open to change and adaptation accordingly to get closer to discovering core-categories and substantiating them with meaning and detail. This adaptive research sampling process is called theoretical sampling (Glaser & Holton 2004). Theoretical sampling allows the researcher to select and control their study cases, people, events, activities etc. through the evolving constructs of the research (Glesne 2011). This means that the decision of what, from whom, when and how to collect data next depends on how the research is developing. Theoretical sampling decisions requires theoretically sensitivity – the sufficient ability of the researcher to formulate concepts and theories as it emerges from data, and therefore selects the right next step in data collection. One principle objective of grounded theory to note is that it works primarily on comparative analysis, it is therefore important that the researcher be aware of the level of difference of the selected comparative groups in terms of their processes, strategies, relationships, structures, sites etc. (Walker & Myrick 2006). Since the phenomenon being studied in this research is inherent knowing acts in projects, target participants were initially designed to be the project committee members and those involved directly with the digitisation project. The sampling circle later expanded to include participants who are involved indirectly; those who are curious and voice their opinions, blue-collar maintenance technicians, and those who have experience working with the current information/knowledge management system. There are also several instances where unlikely individuals appear only once or twice throughout the study, mostly because they were somehow involved with unfolding events relevant to the empirical research. Thus, the total number of individuals who participated in the research apart from the project committee is not exactly known, although a close estimate can be extracted from the recorded notes.

The study covers the first three phases of the digitisation project – definition & initiation, selection & planning, and pre-implementation – across almost 6 months after which the results were fully saturate and triangulated. During the implementation phase and monitor and control phase, the researcher was already going through his thesis writing stage. Before discussing the results and how they emerged through GGT and qualitative document analysis during these first three project phases, it is important to understand what knowledge management systems are and how they run. The next section will introduce a brief about KMS and detail the history of XAX and its use of KMS up until before the 2016 digitisation project.

4.2 The Digitisation Project: A Background

One of the perks of this doctoral thesis is that it is investigates knowledge management practices in project management of a project which itself has the objective of digitising maintenance operations by fusing them with a knowledge management system. A knowledge management system can be broadly defined as integration of knowledge processes with technological mechanisms that enhance knowledge communication and collaboration, boost search and retrieval for users who aren't even sure what they are looking for, build organisational identity and memory, and automate metadata processing for different users with different needs (Becerra-Fernandez & Sabherwal 2015; Dalkir 2011). The differences between an information system (IS) and a knowledge management system (KMS) are hard to discern given that the technology of information systems is what gave rise to knowledge management systems (Alavi & Leidner 2001; McDermott 1999). Some management scholars like Šajeva (2010) and Kebede (2010) consider knowledge management systems a particular class of information systems. Generally speaking however, knowledge management systems are differentiated from information system by invoking the often ambiguous concept of 'context'. Some notable examples of knowledge management systems include wikis, expert systems, case-based systems, semantic networking, metadata processing, and communities of practice (Becerra-Fernandez & Sabherwal 2015). In the empirical field noting, incidents 425 to 437 record an attempt by the researcher to differentiate between IS and KMS in practice by creating an interpretation based on the technicality of the system functions. As the excerpt shows, the difference between IS and KM is not only difficult to establish, but is also a meaningless task in practice:

#	INCIDENT (I#)
425	Upon looking at these examples, I noted that most (not all) operations has two functions: a) the necessary function to get the required work done,
426	b) and the function that makes the carrying out of that work easier, faster, more efficient, and more cost effective.
…….	………
436	I think about that a little and wonder if ‘necessary’ is information management and ‘efficiency’ is knowledge management.
437	I wanted to voice this to HN but then I thought that it’s perhaps better that I not. HN would most likely tell me again not to mix my research with the project.

Another attempt is recorded in a memo note and classified under ‘Research Method’ with the aim of reflecting on how empirical field noting is affecting the way the project is being implemented. The note itself, however, is actually a reflection on distinguishing IS and KMS in a practical sense:

Memo sorted in ‘RESEARCH METHODS’	As I was passing by through the halls one collegue stopped and asked me about my reasearch. I told him its about knowledge management. He couldn’t understand fully what knowledge management is, or what im really talking about. I finally said 'its like information management but in real time'. It was an implusive answer and intially I wasnt statisfied it gave knowledge management its full credit. I guess I just said it to put him off. But in retrospect, I think it is a really interesting way of putting it. Knowledge management is information management in real time

The managing director’s initial interpretation of ‘digitisation’ is the digital transformation and organisation of scattered data present as hard copy documents or in people’s mind. He had no interest in matters related to distinguishing IS from KMS. His interests were placed into another matter that sounds more academic rather than applied. *MZ* realised that what is being digitised is not just the data, *but also the maintenance team themselves*. ‘Digitising the maintenance team’ was never clearly branded as such, but it was implicitly obvious during the demos that took place in the pre-implementation phase. That was a discussion that all the project committee members were ready to talk about and explore because it involves making decisions about access and compartmentalisation, how many users should the company buy the license for, and whether buying the systems handheld app will boost performance. This, unlike the difference between an information system and a knowledge management system, concerns practitioners because it has immediate practical effects and financial consequences.

The empirical study record also demonstrates how in the world of management practitioners, academic monikers like ‘expert systems’, ‘content management systems’, and ‘case-based systems’ don’t mean much to them. Systems are labeled according to the management operation they cover; so for example CMMS stands for ‘Computerised Maintenance Management System’, CAFM stands for ‘Computer Aided Facility Management’, and IWMS stands for ‘Integrated Workplace Management System’. When an organisation decides to purchase and implement such management systems, they look for the virtual functions and capabilities the system can employ to enhance the real-world operations. Their first hint is obviously the names of the systems. By the time they have gone deep into signing the contract, they would have already understood that the difference between different management systems are ambiguous. Companies often take that into their advantage to request importing or customising new functions thereby molding their system to meet the unique characteristic processes of their operations.

Digitisation projects are not new to XAX. The company is already operating on (codename) Clerk – a simple ERP system, and (codename) Banktower – a simple search and retrieval system. Clerk connects the two head companies of Dubai and Sharjah and is run by the leasing and the financial departments. As the minimum requirements of leasing and finance grew within the company, so did Clerk. Customisation and upgrading are a frequent activity that the leasing and financial departments got used to. The customisation visits from the software developers would often happen at the end of the week on a Wednesday or a Thursday, at which time the accountants and leasing officers are ready with data backups and for a demo session on the upgrades. Though Clerk also has functions for maintenance operations, they were too simple and too little. When the maintenance department started using Clerk, they realized that they are only putting in the extra work of duplicating data. Clerk was very limited when it came to maintenance operations and could not reciprocate with results like it did with the leasing and financial departments. The maintenance team eventually stopped using Clerk and continued working in its own longstanding and familiar hardcopy procedures and processes. The managing director *MZ* was aware of the limitations of Clerk towards the maintenance operations and he considered that an opportunity. He referred to Clerk as the 'transition phase' of the digitisation project; his main aim was to get employees acquainted with working alongside digitally systemised procedures.

After Clerk was applied and run for a long time, another system was introduced to XAX codenamed Banktower. Banktower is a simple electronic records system initially meant to digitise and store architectural drawings and plans of all the buildings run by XAX. There were hundreds of these drawings; some by consultants, some by third part civil services, some approved, and some modified etc. There were also several hundred layers of schematics –electrical wiring, fire systems, plumbing flows, cooler systems, building structure etc. *MZ* and operations manager *AR* later agreed that Banktower hold other than just architectural drawings, and a massive rearrangement of various hardcopy documents divided them into drawings, communication, and contracts were later scanned and uploaded into Banktower. Unfortunately, due to disturbances during the course of documents collection, scanning, and uploading, the search and retrieval process was partial and flawed. Empirical record from incidents 181 to 184 reads:

#	**INCIDENT (I#)**
181	These files were lost during the collection stage. Although Mr. [AR] specifically stressed that they plan and divide their collection process, it was very messy (to reduce their transportation expense) and the files got mixed.
182	Once returned, they were not appropriately allocated to where they were collected from. They were mixed up even more and put in the outside corridors altogether. Our team had to spend time rearranging the files upon which they realized that some were missing.
183	In all this chaos and mix up it was impossible to determine if indeed all files were scanned and returned.
184	Mr. [AR] thus faced problems when searching for documents in the system: either it takes days to find, or it's not in the system at all.

When the 2016 maintenance digitisation project was initiated by *MZ*, he was yet optimistic and viewed these shortcomings as lessons learnt and opportunities. He was convinced that the transition phase of Clerk and Banktower had given the required experience for a fully digitised management office. In a meeting with the operations manager *AR*, the financial head *GPL*, and the leasing officer *ADT*, it was agreed that a new system is to be implemented, one that can cover every single operation and 'remove the human factor'. The system would start as a maintenance management system and later either integrate with Clerk, or expand into fully satisfying all departments and push Clerk out of the way. Whether the new system would integrate with or push out Clerk is the point of disagreement in the meeting that led to the fluctuating constraints. It was agreed to keep that window opened until more information showed up upon which a final decision could be confidently made. This point marks the initiation of the 2016 digitisation project which is the substance of the empirical research for this doctoral thesis. The next section will discuss the ethical considerations the study has undertaken before delving into the results.

4.3 Ethical Considerations

Research ethics are those moral codes of conduct that define how researchers formulate, design, implement and present their research topic. Its principles involve a variety of matters such as gaining accesses, confidentiality, data veracity, and plagiarism issues (Saunders, Thornhill & Lewis 2011). Design and implementing a research topic under ethical conduct require that it be morally defensible and methodologically sound. Oliver (2010) argues that research ethics are especially basic to social sciences since it involves human subjects. Ethical conundrums happen often and it is the job of the researcher to do everything he can to make the choices he believes to be moral so that he/she retain a sense of dignity and worth not just to the research, but to everyone involved.

Practically speaking, the researcher should avoid causing harm, distress, anxiety, pain (in experimental cases) or any other negative feeling to participants of the research, directly or otherwise. This would also include consideration of environmental issues such as reducing paper usage, financial issues such as moral utilisation of grant budgets, and participant protection issues of privacy such as exposition of personal information. All these aspects of ethical research conduction aren't simple as such; rather they present themselves as dilemmas. Guillemin and Gillam (2004) write about the 'reflexive researcher', who expects and accepts that ethics in research has different dimensions of morality; what may seem moral to one may seem otherwise to another. A reflexive researcher therefore, can anticipate potential ethical dilemmas before they happen which gives him the advantage of reducing its potential consequences. It was the request of the managing director that electronic recording tools, such as sound recorders and video cameras not be used for the research that kick-started the ethical subject matter of the research. The only method the researcher was permitted to record data through during observation was via field notes. The managing director also implicitly requested that software provider companies and third party contractors with XAX also not be disclosed.

This doctoral thesis then took the necessary steps to uphold the ethical and moral conduct of doing social research. A policy of research ethics was drafted after acquainting with the research setting and before conducting the empirical investigation. These ethical steps were included in the invitation to participate in the research which circulated to the XAX staff and was put up on the announcement board. This was a relatively easy task because a) the researcher is an employee b) the researcher is also a committee member of the project being researched, and c) this is not the first time XAX allows academic research to be conducted on its grounds which makes d) XAX staff comfortable and encouraging in an academic research environment. The ethical policy enclosed assurances for identity protection of all staff wishing to participate and guaranteed that sensitive social matters within the digitisation project or throughout XAX will not recorded. Before the second stage of the empirical research – qualitative document analysis – there was verbal agreement between the participants and the researcher to not publish the documents and emails involved in the study. The way this ethical task was carried out was by first arranging the details of the documents and emails relevant to the research under pseudonyms, and second by analysing the contents in a manner that allows it to be published without the revealing what was agreed to be confidential.

Admittedly there was some difficulty to assigning pseudonyms. There were so many organisations and individuals who were happy to contribute to the research especially during selection and planning phase where several meetings and demo sessions from different software providers were taking place. Qualitative document analysis was somewhat strenuous too; the researcher had to go back and contact those who accept their documents to be part of the research to explain and agree that some content may be disclosed as part of analysis. Apart from those two issues, conducting ethically appropriate data recording and data analysis was smooth and simple because the researcher is both an insider to the company and a member of the digitisation project committee. This allowed an easy quick access to required information, and exposed the researcher to exactly the desirable data for recording and analysis. The next section will demonstrate in details how the empirical record was designed, and how this design aligned with the Glaserian grounded theory and qualitative document analysis' data collection and analysis processes.

4.4 Results

It has been established in the literature review that the knowledge-evolving project is a knowledge management manifesto of a typical project; one that institutes all the necessary knowledge at the outset and builds on it as the project emerges. This knowledge clearly is not dormant, it actively directs and guides the project stakeholders into taking the next steps, and in effect, its own evolution. Thus, it is reasonable to assume that knowledge exploitation practices overtake knowledge exploration practices in a typical project context. While the literature review was deeply concerned with the knowledge-evolving project, it did not investigate what knowledge exploitation acts are and how they materialise in practice. This was the bearing that the researcher entered the empirical field with: the justification and rationale of examining the knowledge exploitation acts rather than knowledge exploration acts. This way, the researcher sustained both focus and open mindedness on the subject matter as it unfolds in the empirical field.

The Knowledge Evolving Acts

All the four knowing acts – inscription, technological extension, redundancy, and discussion – discovered by the method of grounded theory, first revealed their properties early on in the empirical study. For most of the remainder of the data collection and analysis stages, the core categories were taking shape and form. During these first few weeks when the properties of the knowledge evolving acts were being revealed, the researcher was wondering about the characteristics and nature of knowing acts in general regardless of whether they were exploitative or explorative. This was important for two reasons: first, the researcher wanted to define 'knowing acts' based on the analysis from empirical research rather than literature review, and second, the researcher wanted to determine the set of rules that appropriately identifies a knowledge evolving act when it transpires in an incident. The researcher first started pondering on the idea of defining knowing acts in terms of what is in the process of being known. He proceeded to create a category 'knowing ways' which branches into 'knowing modes' and 'knowing acts':

Memo sorted in 'KNOWING ACTS'	What do I mean by knowing ways (modes & acts?)? The answer I found in Ahern, Levy, and Byrne (2014) . When I say 'communicative and taxonomic' Im talking about "static and explicit 'known' knowledge (design etc.)". Knowing acts for me is the dynamic " 'knowing' knowledge (know-how etc.) which leads to an expectation of learning". This is a helpful way of what I mean by knowing acts, but I guess not exactly what Im trying to say. no, no its not.
Memo sorted in 'KNOWING ACTS'	Knowing ways could mean the different ways of knowledge formation. Actionable knowledge. Recommendations. Knowledge that affects a project. Knowing ways "implies the need to generate knowledge continuously over the project life cycle" by means of using standard KM processes. Knowing ways gives all standard KM processes a peculiar ability at knowledge formation.

This idea of knowing ways as divided into 'knowing acts' and 'knowing modes' was not sitting well with the researcher's thinking. But it did introduce something important to the researcher's mind; that there is knowing in the ontological sense and there is knowing in the epistemological sense. The former – knowing in the ontological sense – refers to knowing practices that are related to organising or storing knowledge in an efficient and effective ways so that the concerned person would be able to reach the knowledge they require as fast as possible and as easily as possible. The latter – knowing in the epistemological sense – refers to knowing practices that are related to comprehension and interpretation of the knowledge sources that has reached the concerned person. This was one of the most important aspects of 'knowing acts' discovered. It took the researcher into reeling with it across different scenarios of knowing as a consequence of either acquiring or structuring of data:

Memo sorted in 'KNOWING ACTS'	Organizing: to put things in order Structuring: to create order for things
Memo sorted in 'KNOWING ACTS'	Every time you shuffle around the same information, you create new knowledge
Memo sorted in 'KNOWING ACTS'	it seems that for a set of data, the more you dig into it the more you know. You can shuffle it many times and it will still look different and produce more knowledge
Memo sorted in 'KNOWING ACTS'	It seems that one of the things that defines the kind of data to be extracted from a knowledge source is the purpose of using that knowledge. Different purposes can pool from one knowledge base and end up with different information

Sometime later the researcher recognised that the knowing involved in communicative and taxonomic practices that are concerned with storage, transfer, and organisation of knowledge sources is not so different from knowing involved in knowledge acquisition and identification. He was not able to point at where exactly ontological knowing and epistemological knowing diverge, although there was clearly some kind of difference. This difference however, was difficult to identify. For example, the person(s) tasked with organising and building the database for knowledge to be distributed and fetched by other users are not absent mindedly organising data by keywords. It was necessary that they understand the data and dig deeper into it to create the efficiency and effectiveness of the search and retrieval:

#	INCIDENT	OPEN CODING
1147	SHD tells me that sometimes it helps to punch the same data more than once though into three different softwares.	*data duplication helps
1149	He also told me that GPL usually experiments with excel sheet (by creating new functions for finance and testing them see how they work) and if he is successful at creating a new function, he asks the people from CLERK to add it in their system.	*GPL experiments with the excel sheet *creates new finance functions and tests them *if successful – implements function it on CLERK
1150	GPL also tries to recreate the functions of CLERK on excel to boost the speeding of data replication to excel. In fact it was this way that GPL got the idea to create new functions.	*recreating functions of CLERK on excel *purpose: to boost data replication rate *this is how he got the idea *idea to create and test new functions on excel

In fact, the researcher himself experienced this type of learning because he was tasked to create a data sheet with the technical specifications of all the maintenance assets in use and maintenance items in store:

#	INCIDENT	OPEN CODING
1296	I'm working on technical specifications again. I had trouble deciding how deep I should go (details level and number of tech specs cells).	*working on tech parameters again *difficulty: how deep should I go *detail level and number of cells
1297	I finally decided that each item subcategory gets 2 extra slots of specs (spec 1 and spec 2).	*finally deciding *making a plan *2 extra unspecified parameters
1298	As I studied the different specs of different item subcategories (wiring, cables, sockets, motors, exhaust fans, transformers, buttons etc.), I keep learning something new.	*studying different tech specs of different items *keep learning something new

Sometime during the beginning of selective coding, while still wrestling with a solid definition on knowing acts, a flash image of the literature review passed through the researcher's mind. He recalled that knowing acts are the *de facto* real-life practices that fulfill the *de jure* objectives of knowledge processes. At this point a momentous connection was made between knowing acts/knowledge processes and ontological knowing/epistemological knowing: where knowing acts are what was interpreted as epistemological knowing, knowledge processes are what was interpreted as ontological knowing. It is summarised in the following memo:

Memo sorted in 'KNOWING ACTS'	Communicative and taxonomic (ontologic): - who gets it -how to store it -how to transfer it -right person right place -third stage of KM (containers, communities, contents) Knowing acts (epistemic): -what happens when one gets information -how one understands, learns, recognize, grasp, comprehends, reconize, realize, percieve, interpret information"

Knowing acts – as a theory grounded in data – are finally revealed to be the *epistemic practices* involved in the ontological processes of managing knowledge and knowledge sources. Knowing acts implicate elements of thought such as comprehension, realisation, and interpretation of the knowledge sources being maintained and run by the ontologically based communicative and taxonomic knowledge management processes. Each of the four knowledge evolving acts discovered in this doctoral thesis excites different epistemic element of thought when applied to interact with knowledge sources:

Memo sorted in 'KNOWING ACTS'	Interact with _________ using ___________to amplify a project's ability at knowing: documents: Inscription practice: Redundancy technology: Technical mediation People: Discussion & Dialogue

As evident in various incidents, the memo mentioned above is *not* meant to restrict a specific knowing act to interact with a specific knowledge source; each of inscription, redundancy, technological extension, and discussion can be applied to interact with every knowledge source. Knowing acts occurred all the time and they occurred simultaneously across different knowledge processes. It is impossible to identify one knowing act to exclusively one knowledge process:

Memo sorted in 'KNOWING ACTS'	Far too often all 4 knowing acts happen at the same time. During this duration however, one of these processes seem more obvious than others. I think that redundancy was the one process that is least obvious to discern. It is always hidding somehow
Memo sorted in 'KNOWING ACTS'	all four knowing acts have one thing in common: they have no start point and no end point. Each knowing act can be started from anywhere and end anywhere

A definite decisive definition of knowing acts as explored from empirical grounds was revealed much later closer towards the end of GGT. One might wonder: how then was the researcher able to observe and explore the four knowledge evolving acts before he had a clear understanding of what knowing acts are? The answer is that the properties of the four different knowledge evolving acts are exactly what informed a specific explicit definition of the 'knowing acts'. It is truly interesting how this empirical research went, because it should have been the other way around. Each of the four knowledge evolving acts have unique and different properties and theories that will be discussed in the next section. The one thing they have in common is:

Memo sorted in 'KNOWING ACTS'	The word 'wonder' seems to pop up every time there is a discussion going on. It also pops during inscription practice. And mediation and redundancy (55 times)
Memo sorted in 'KNOWING ACTS'	The word 'idea' shows up every time there is redundancy, discussion, inscription, and mediation (120 times)

Inscription – The First Knowledge Evolving Act

It is clear from the empirical research record that from day one, the researcher was looking for some sort of learning technique that individuals practice to build up the preliminary knowledge base of the project. The researcher was faintly aware of one particular method but had no clear conception of it; the method was the quick skim reading of existing documents and the rough writing on subject matters related to their contents in an effort to understand, explain, or discuss. The word ‘documents’ here is implied in the broadest sense and includes any digital or printed material relevant to the project; from brochures, to proposals, to charter, to reports, to instruction manuals. Curiously, these rough noting were not necessarily only done on physical documents, they were also done by entering keywords or highlighting some texts or pages or adding comments on digital documents. The resulting scribbled physical papers and digital documents are not discarded; rather, they are kept as valuable information for later use:

#	INCIDENT	OPEN CODING
27	A first skim through makes me and HN suspicious. HN says in Arabic “mesh mertaha” literally meaning “I’m uncomfortable”.	*first skim through *HN is uncomfortable with it
29	We scribble all our thoughts down on the documents. We also note in red what is missing from our opportunities list.	*scribbling thoughts on documents *noting in red what is missing from opplist *red to draw attention
396	I go back to my desk and update the opplist from the scribbles we have done on the [Software Provider 3] documents and the notes we have kept through all the meetings and researching:	*updating opplist
849	One of the technicians took the plan from the pocket and opened it. Everyone seemed to have an explanation and they were sketching their suggestions on the plan and on the rough papers, trying to connect the dots and make sense.	*technician pulling pipe drawings from pocket and open it
1417	All of the research documents and files were stored and he used them for later: installing new chillers.	*all documents were kept *used later for a different project: installing chillers

Memo sorted in 'Inscription'	I'm starting to realize a significance to scribbling and jotting on physical papers. I think it makes communication better and it makes our activities easier and faster. Reminds me of boundary objects. (Sapsed, & Salter, 2004)
Memo sorted in 'Inscription'	many incidents show that inscription is not just the sharing of ideas or the writing down of ideas, but is also is a way to come up with new ideas. Ideas pop when inscripting
Memo sorted in 'Inscription'	Inscription was the easiest knowing process to observe and record. It was clear as sky and it occurred frequently

Interestingly, this method was not always an individual effort. There were many incidents where the rough document or sheet, digital and physical, is scribbled on by two or more people who are trying to explain something or argue a point:

Core Category	Document(s) Selected	Data Analysed
Inscription	D88, D89, D90, D91	Various handwritten or digitally types notes collected from scribbles on empty notebooks, word files, empty A4 papers, and printed out documents. As you flip to the next page on each of these documents, you could see the progress being made. Some of these documents contain one handwriting, some more than one. Some indicate clear calculations, reminders, and underlines, others show a struggle of understanding.

Memo sorted in 'Inscription'	co-inscription is when many work on inscripting on one paper or digital screen
Memo sorted in 'Inscription'	inscription can be a collective activity. Inscription could be done in presence and participation of multiple inscriptors

More interestingly, the researcher also noted how rough noting is more diverse an activity than just a matter of scribbling for learning or for explaining. It was also a way to organise and manage:

#	INCIDENT	OPEN CODING
109	I couldn't help but think about those sticky notes and why she threw them in the garbage bin: at first, I thought them to be reference notes. I realized that HN intended for them to be updating notes.	*thinking about sticky notes *wondering why throw them *not reference notes, updating notes
110	Every time there is a progress she jots it down on the sticky pads. Once the file is complete there was no need for the notes to be left on the files. I told HN these thoughts to confirm them to me and she did.	*once new progress is done, scratch the old progress note. *once file complete: no need for sticky notes *HN confirms my thoughts

Memo sorted in 'Inscription'	This incident notes a very interesting part of inscription. By keeping papers unstappled, HN could spread them across the table or next to each other and make her inscription process easier faster, not losing trail of thoughts while looking for that paper she has stappled
Memo sorted in 'Inscription'	sometimes, like this incident, some documents are prepared specifically for rough noting. They are designed to enhance and organize one's rough notes

During these first couple of weeks, the researcher was also realising that some form of rough documents are preferred more than others. For example, physical papers are preferred more than digital documents; colored papers are preferred more than black and white print; and visuals such as screenshots and diagrams or tables are preferred more than words written continuously:

Memo sorted in 'Inscription'	In a lot of incidents we insist of physical papers. This is because physical paper is better/faster to draw/sketch/scribble/inscribe on, which is better to explain/describe and make a point
Memo sorted in 'Inscription'	I think colour printing is not just better for scanning with your eyes comfortably, but also important because soe documents have key functions coded in colour. And besides, it's easier to share printed paper, easier to pass around when you are in a meeting or want to show something to someone. Easier to point around too, to explain this and that. Maybe so are digital documents on hand held devices. But I mean it would be so comfortably

	shared and discussed around than if it were a physical paper. It wouldn't be as easy
Memo sorted in 'Inscription'	We learnt from screenshots more than we expected to. Visuals are very powerful like that

It was sometime later that the researcher connected the dots together and realised that rough writing and skim reading are part of a bigger process of documentation; a closed loop activity of using official documents as a reference for rough noting and using rough noting as the base for producing new documents. The researcher was looking for a proper name to give to this unique knowing practice which is highlighted by its physical knowledge (written or scribbled somewhere) being in a state of development and progress. Coincidently, during this time it so happens that the researcher was also wondering about the epistemic differences between processing scientific knowledge and organisational (business-centered) knowledge, which eventually led him to Latour & Woolgar's (1979) *Laboratory Life: The Construction of Scientific Facts*. The concept of '*inscription*' in Latour & Woolgar (1979) perfectly explained the closed loop cycle of document creation and reference, and hinted to other applications that could be explored on the empirical grounds to understand more. It was then that 'inscription', the first knowledge evolving act, was beginning to materialise and substantiate. What is most striking about Latour & Woolgar's (1979) 'inscription' is the focus on physical knowledge (knowledge as words or drawings) as it is in the stages of being formed rather than after it has been completely formed. Latour & Woolgar's (1979) bring our attention to the rough notes that are scribbled by scientist to record their thoughts, register instrument readings, copy excerpts from books, or perform calculations of experiments in form of written words or drawings. These rough noting are later revised by peers, colleagues, or supervisors, who input their ideas through variations of red markings, highlights, comments, and suggestions. Finally, all the scrambles of rough notes come together to create the final official manuscripts, such as a research paper or an instruction manual. These published research papers or instruction manuals are not just stored on a shelf; they return back to the inscription cycle because they are being used as references in the new scientific investigations. Of course, there certainly are differences between inscription in a project management context and inscription in a scientific laboratory; for example, inscriptions that were taking place during the 'digitisation project' of XAX is closer as a knowledge externalisation technique than as a knowledge production technique. This is because the content of the scripts themselves are mostly about the immediate world around us (such as maintenance operations flow charts and maintenance items technical specifications) rather than concepts that are outside what we normally experience (such as electron clouds or black holes). Nonetheless, inscription as a knowing act was clear as day in XAX, and it was exactly as Latour & Woolgar's (1979) has described.

As noted earlier, inscription is a loop. The loop closes around scribbles produced for learning, and official documents pulled for referencing. Inscription is divided into three stages: *transcription*, *cascading*, and *cycling*, and can starts as pre-existing in any of the three categories. Documents (hard or soft) existing in the *transcription* stage are in the earliest process of being created. They include free written rough notes, rough sketches, scribbles, red pen corrections, marker highlighted sentences, page markers, sticky notes, and reminders on written/printed or empty papers. They are what one might call 'secondary documents':

#	INCIDENT	OPEN CODING
29	We scribble all our thoughts down on the documents. We also note in red what is missing from our opportunities list.	*scribbling thoughts on documents *noting in red what is missing from opplist *red to draw attention

35	We study each file carefully, jotting down notes, circling key words, highlighting important functions, canceling out unneeded or redundant functions, and even using sticky pads on each file.	*studying each file carefully, closely *jotting, circling, highlighting, canceling, sticky pads
1096	She's taking down notes and circling highlighting texts. HN had sent a request for quotation and is waiting for a reply.	*collecting data from email and brochure *taking down notes *circling and highlighting texts on brochure *sending a request for quotation *awaiting reply

It was noted during the empirical exploration that documents in the transcription stage were not only scribbled by the future author, but also by others who are part of the project. Transcriptions (scribbling) was used to understand, explain, identify, and create knowledge individually or as part of a group. Several incidents show individuals as well as groups scribbling on documents as an attempt to understand, explain, or discuss it. Sometimes it's just one document that more than one person is scribbling on. These rough notes are more often kept than thrown away.

Documents existing in the *cascading* stage are those in the process of being appropriately and comprehensively written for official circulation around the company. Cascading includes integrating different notes or documents (scribbled or official), updating information in documents, and going through officialisation processes. The term 'cascading' was chosen to illustrate a sense of pouring different knowledge sources (scribbled and official) into a one whole finalised document(s):

Memo sorted in 'Inscription'	feedbacks and opinions and decisions are processes of cascading in inscription
Memo sorted in 'Inscription'	inscription processes directly impact presentation. How one inscribes in the early stages of the document can affect how it is finally to be presented. In this case the finalized document is made impossible to print out because it has so many cells horizontally and vertically. I think this is also a mediation issue.

Core Category	**Category**	**Properties**
Inscription	Cascading	getting opinions, feedbacks, additional points from others - building on those opinions
		dividing documents into sub documents for different purposes/ for different departments/
		revising work done, making sure it's ready to store, to share, to make official – editing

#	INCIDENT	OPEN CODING	SELECTIVE CODING
1797	As we revise the 'Supplier Profile' and 'Purchasing' from [Software Provider 7 / SOFTWARE FF], HN opens up the files of the other software companies.	*revise files *use other files as reference	Discussion Inscription
1798	She said "we will inspire our supplier profile and purchasing from other companies". She specifically opens up the [Software Provider 2] file.	*inspire ideas from other companies as reference	Inscription
1799	We are now scribbling down what we think should be changed, should be fixed, should be there, and what is ok.	*scribbling *what we think	Inscription Discussion

Documents existing in the *cycling* stage are those being arranged on shelves or organised in software files. Incidents show that cycling documents include archiving processes, search and retrieval enhancement, compartmentalisation of access, and provide information about the contents, whereabouts, and access options of the documents. The term 'cycling' was chosen to illustrate a sense of documents re-entering the inscription loop to be used for referencing after they have been finalised:

#	INCIDENT	OPEN CODING
1281	I'm working on the technical specifications of categories-subcategories-items. As I'm preparing this excel sheet, I'm using previous excel sheets as a reference (I wonder if	*working tech parameters *preparing new excel sheet *using previous excel sheets for help *information source: public sharing folder *wondering if they were used before

	they were ever used) from the public sharing folder.	
1522	She might also want to take a quick look through at the registered items, or keep it for future reference (she may need it I think to myself).	*also *a quick look might help her *she can keep it for potential future reference

As previously stated, documents can pre-exist anywhere in the inscription loop and move from transcription to cascading to cycling and back to transcription (figure 4.1).

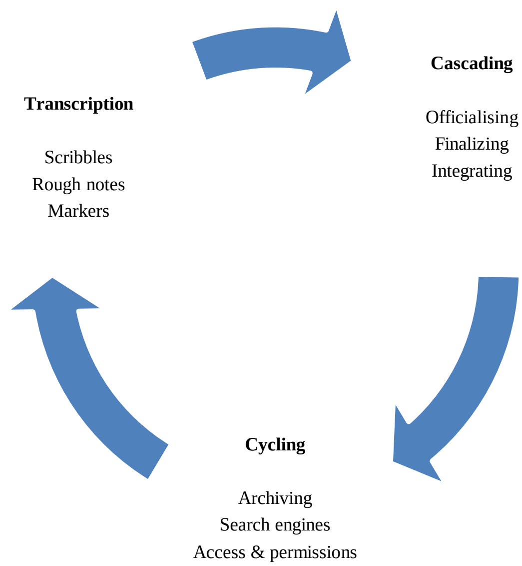

Figure 4.1: Inscription – the physical word cycles through primary and secondary documents

Indeed, inscription is a knowledge evolving act with powerful knowledge *exploitation* potential *because documents start preexisting within all three stages at any point in time*. On another note; although this was not observed in the empirical study, there is no reason why documents in the transcription stage can't skip straight to cycling without going through cascading.

One of the interesting aspects uncovered about the inscription cycle (transcribing, cascading cycling) is the method of inscription preferred during each of the stages:

Memo sorted in 'Inscription'	There can be inscription digitally and physically. Digital inscription is more efficient when cascading and cycling, but physical inscription is more efficient when transcribing

Another noteworthy aspect discovered about inscription is that it mostly makes sense only to that person who has created it:

Memo sorted in 'Inscription'	inscription at its rough stages is rather unintelligible to other than the person or group who made them

#	INCIDENT	OPEN CODING	SELECTIVE CODING
1523	But she insisted that I clarify some things so I did. She used highlighters and different coloured pens and her notebook to note down a concept I explained to her (about safety ratings IP).	*insisting I clarify some things *using highlighters and colored pens *using her notepad *writing what Im explaining	*clarify *transcriptions to explain *transcriptions to understand
1524	There was even a mix up with a page number and a specs number at the top of the page that I had to explain/clarify!	*mix-up: page number and item number *due to rough noting	*rough noting unintelligible

In conclusion, it is important to note that inscriptions can also act as an institutionalisation process since knowledge that is collectively scripted progressively among human agency as a learning technique creates shared understandings and maintains cognitive and institutional order. In this way, inscriptions are a learning exercise as well as standardising one; they are reflexive, spontaneous, evolutionary, and institutive.

Technological Extension – The Second Knowledge Evolving Act

'Technological extension' was the only knowledge evolving act that the researcher struggled to name. Between 'technical', 'technological', 'mediation, 'delegation', and 'extension', the researcher had to construct the right term so that it's best self-explanatory of the concept it implies:

Memo sorted in 'Technological Extension'	Technology is defined as the tools which extend or improve our physical or mental abilities to perform a task Latour and Heidegger, Riis, S. (2008). The Symmetry Between Bruno Latour and Martin Heidegger The Technique of Turning a Police Officer into a Speed Bump. Social Studies of Science, 38(2), 285-301., Woolpert 'the unnatural nature of science'

Technological extension's first clue threads appeared in incident 386, as revealed in the empirical research records. A discussion surrounding management systems was taking place between the operations manager, the project coordinator, and the maintenance engineer/researcher:

#	INCIDENT	OPEN CODING
386	He said take for example the accounts in Downtown Dubai: the whole of Downtown Dubai is run by one accountant.	*example: all Downtown Dubai is run by only one accountant *the system is very powerful, and its processes are modified to run according to the company structure (flow) *it only needs one accountant to drive the whole accounts department

In the incident, the operations manager gave an example – thereafter referred to as the 'cyborg accountant example' in the analysis – that highlighted what his ultimate expectation of what the management software would be. The 'cyborg accountant' is an accountant who runs the whole of all the accounting operations of Downtown Dubai on his own. The accountant is neither a genius nor talented; but rather, most of his cognitive operations has been extended to a powerful accounting system. AR contrasts the 'cyborg accountant' with XAX's accounting department where as much as five accountants are working for a mere one building.

The term ‘Technological Extension’ was selected because the word ‘extension’ offers a linguistic image meant to describe particular natural cognitive faculties ‘extended’ to a ‘technologically’ mechanical one (Brey 2000). Where ‘extension’ also implies the possible involvement of the natural cognition to run the mechanical cognition, ‘delegation’ implies a completely autonomous independent mechanical intelligence; a level of advancement science and technology is yet to reach. The term ‘technological mediation’ was also considered, but likewise later rejected. Borrowed from Latour’s (1999) *Pandora’s Hope*, technical mediation is a philosophical concept developed based on actor-network theory where technology meets social construction of knowledge. The problem with technical mediation is that it emphasises a philosophy of knowledge that exists only in the interaction of socio-technical forces. This is obviously contradictory to the adopted evolution of intelligence theory.

During the early stages of uncovering the properties of the knowing act ‘technological extension’, when the term designated was ‘technical mediation’, the researcher came upon the thought that technology had nothing to do with this particular knowing act. It could simply be ‘mediation’ between the knower and the information or data, regardless if said information or data is in digital or physical form:

Memo sorted in ‘Technological Extension’	Going back through my notes and I get a thought: mediation is not just technological. Mediation is basically 'how you approach data': what data do you choose to include/exclude/change/alter/organize/structure/relate etc. That gives rise to knowing

For the researcher, this knowing act was more about organisation or structuring of information than about using technology to develop and build on pre-defined knowledge. This idea stayed with the researcher for a long while, a month or so, and the researcher wrestled with interpreting how ‘mediation’ could properly be defined as a knowledge evolving act:

Memo sorted in 'Technological Extension'	While mediation originally came from technical mediation it eveloved into something much more. The evolution came with the realization of two things: 1. systems are the interaction pods between information database and the user rather than being the information iteslf, and 2. interaction pods can be manual (physical documents and calenders and reporting methods), as much as they are automatic (systemized). In fact, it seems that in this project what we really are doing is digitizing (systemizing) manual calculators

It was incident #1365 that brought the idea of the 'calculator' which put back the 'technology' into 'technological mediation':

#	INCIDENT	OPEN CODING
1365	AR thinks that MZ's idea of the software is to have information about everything stored digitally. But that wouldn't do any good. It will just be extra work of collecting and storing data. The software has to be more than that. HN then proceeds to explain to AR that it's not just a program for dumping data, it is also like a "calculator", and it will help in making decisions. AR was glad to hear that and said that he was waiting for that kind of answer. The software should be "part of the team" he says and not merely a storage device.	*AR interpreting MZ's objectives *everything information stored digitally *not useful: extra work of collecting and storing data *HN explaining *software is a "calculator" *will help make decisions *AR: glad to hear that *software: "part of the team" not storage device

Throughout the next incidents, the researcher was inserting 'calculator' anywhere properties of 'technological extension' appeared. He later realised that calculation is merely one ability of technological extension as a knowing act. There is much more to it:

#	INCIDENT	OPEN CODING	SELECTIVE CODING
1568 b	I tell HN that I'm working fast on the tech specs data sheet, but because I have an older version of excel (2003) on an old platform (windows XP) on an old computer (Pentium 4) a lot of 'softwarey' things are delaying me.	*working as fast as I can *tech specs data sheet *obstacles that slow me down *'softwarey' things	*cascading *transcribing *calculator = auto mediation

1569	Like for example 1. I cant put 2 window screens side by side and simply scroll. I have to keep adjusting the window screens every now and then. 2. Everytime I want to go to the cell right (out of screen display) I have to scroll right the window to manually adjust the view.	*example *two windows side by side always help *two windows= different data sources *adjusting screen everynow and then *cells out of display screen *have to scroll to access cells	*auto mediation *more knowledge sources in view

Memo sorted in 'Technological Extension'	Given that technology extends our ability to do stuff (Latour), mediation by means of technology is just that: an enhanced ability to create a system of organization of knowledge. Enhanced in terms of communication, speed, options, and calculations. document collection has shown the many different ways of enhancing a creation of a system of organization
Memo sorted in 'Technological Extension'	How to do mediation: using the same data you can create multiple calculators for various purposes. The primary promise of a calculator is to organize broken knowledge: i.e. to create a system of organization for a knowledge purpose (e.g. categories, sub categories); the second promise is to aid in taking decisions: i.e. to make calculations for a purpose; the third promise is to display data easy and simple and interactive (ex. calendar view, bring data to us, simple to navigate etc.). for better understanding the third promise, list MZ requirements

After this memo was written, the 'three promises' of technological extension were identified and used in coding. Technological extension as a knowing act should:

1. Be a programmed system that organises data automatically upon input
2. Be an automated system that produces results based on data input
3. Be an automated system that creates powerful interactive tools between the data and the user, and between users

Memo sorted in 'Technological Extension'	Digitization is an act of knowing. It is meant to create and increase: 1. efficiency of the system-of-organization 2. efficiency of the calculator 3. efficiency of simplicity of use

Given these 'three promises' that define technological extension as a knowing act, it was observed that 'technological extension' could be practiced as a knowledge exploration act or a knowledge exploitation act. Technological extension practiced as a knowledge exploration act is the *developing* of the knowledge system; moulding it to requirements by creating and linking functions that mimic particular operations of the company in the real world. A technological extension practiced as a knowledge exploitation act is the *using* and *customizing* of the knowledge system; feeding the functions and cycling their correlation with other functions to let the system identify, analyse, and assimilate information and notify users about new information in real time:

Memo sorted in 'Technological Extension'	Something is bothering me. I'm thinking that how much ever vendors can fit their platforms with our requirements, they can't fully cover it. Even with our customizations and modifications. It would still be incomplete. I think the only way for it to be complete is to practically implement and run it, then do further modifications. Which I guess will command a change on the practice itself. the the practice itself will impose a change on the system. Its a two way mechanism between proposition and practice.
Memo sorted in 'Technological Extension'	I think its important to be <u>directly involved</u> (and not just involved) with any software management platform an organization plans to implement during all the project phases. Leaving everything up to the vendor is not a good idea (we have seen that mistake in Clerk). Every single detail and every single step needs to be monitored and controlled not just by the vendor, but also by the client (the company) itself.

Since this doctoral thesis is interested in investigating the knowledge evolving acts, 'technological extension' here refers to the knowledge exploitation practices of using and customizing a management system rather than developing it. Through grounded theory, technological extension was deduced from three categories (earlier known as the 'three promises') that reveals how knowledge is being evolved with the magic of technology; 'system of organisation', 'calculation', and 'interactivity'.

The first category, ‘system of organisation’, refers to the virtual structuring and flow of functions, their integration, and the order with which information are fed or yielded. The capability to edit the way a system is organised is usually granted to the users by the developers provided that the options to do so are at a simple level of configuration. Nonetheless, there were incidents where some developers agreed to grant and even train XAX (the users) the ability to edit at a deeper customisation level. Different modifications to the organisation of the system’s structure and functions yields different results for different users for different purposes. This is important for the knowledge-evolving project that is learned as it emerges; functions, their correlation, and the information they process need to be flexible to account for the changes in building new knowledge on the existing knowledge base. Every time the system of organisation of a software is modified, its ability to evolve knowledge changes:

Core Category	Document(s) Selected	Data Analysed
Technological Extension	D1, D17, D77, D78, D79, D80, D81	These documents show a cybory being designed to facilitate a higher potential of data input and storage. As the design progresses, it is evident that new ideas are being generated in the successive creation of these documents.

Memo sorted in ‘Technological Extension’	This very interesting idea came to me while I was chatting with SHD. He suggested that a software can do my work This thought means that a system can create an organization of data automatically by feeding it chunks and chunks of nonsensical data. It is nonsense of course, but as we discuss the hypothetical situation further, i grew more and more into understanding what a 'calculator' really means when HN said it. and I related it to mediation. The resulting idea was wonderful.
Memo sorted in ‘Technological Extension’	Mediation cycle (or not): organize data, create system of organization, use system of organization to collect data and store data and produce results, let new data collection/calculation/decision amend system of organization

#	INCIDENT	OPEN CODING	SELECTIVE CODING
1922	HN and I are discussing the types of customizations: functional, structural, visual, architectural, and technical.	*discussing *types of customization	In TE
1923	Functional: is how specific fields calculate variables and/or draw what variables	*calculate/draw/variables	TE
1924	Structural: is how fields relate to each other (tree, flow, top-down, down-up) and what fields are related to each other	*relation of fields	TE

The second category, ‘calculation’, refers to the extension of the real-life emergence of a project and project operations into digital simulations of it. The simulated project contains automated functions that analyses project progress in term of project management processes and product-oriented processes, and interpolates outcomes and expectations for stakeholders. Virtual project management functions and product-oriented functions are not just analysis operations; they are communicative between stakeholders in real-time. The system itself can automatically order dwindling items, renew contracts, adjust the logistics chain, and send KPIs and progress reports at the end of every week. The term ‘calculation’ was chosen to highlight two concepts: a) the ability of the system to organise (calculate) data feed into specific defined databases to produce controlled output, and b) the ability of the system to build (calculate) new information from data feed. It is in this process of organising and building on previous data that knowledge exploitation is being exercised:

Core Category	Document(s) Selected	Data Analysed
Technological Extension	D86, D87	These KPIs are a test of the capability levels of the cyborg in action. There are many ways to group different functions and create a KPI. Every time a new KPI is created new ideas get generated. This is evident in the separately made KPI tests in two documents.

Memo sorted in 'Technological Extension'	CMMS, CAFM, ERP are different platforms that interacts with the same data differently. And the different ways you interact with data generates different POV and so different knowing. This is mediation. Technological mediation in this case.

#	INCIDENT	OPEN CODING	SELECTIVE CODING
282	Reporting of all kinds should be automatically generated and be made editable so that we could use our own formatting.	*reporting: editable auto generation	
287	Preventive maintenance scheduling should include forecasting maintenance depending on MTBF calculations (predictive maintenance).	*Preventive maintenance should include predictive maintenance functions	
1653	I asked him what about performance indicators and he told me his KPIs would be different from out KPI's. His KPIs could be balance sheets, or an account statement, our KPIs are no. of hours on site or MTBF, or job costs.	*thinking: performance indicators match? So data must be same *KPIs different	*knowledge calculators common grounds
1654	But it could come from the same data! GPL puts it this way: "it is two different planets, two totally different things, you are on Mars and I am on earth."	*same data source, different for KPIs *analogy: two different planets *Mars and Earth	*same knowledge can yield different data based on different calculations for different purposes

The third category, ‘interactivity’, refers to the method and manner with which the system allows the user to interact with the data. This interesting notion that a software is a communication channel between user and data rather than being the data itself first started as a comment made by a software provider to explain how massive amounts of data does not lag the management software; the management software exists in one database (or even a whole dedicated server) and the data itself can exist in another. Every time the software manipulates data, the new information created is also stored outside of the database where the software exists. All the software is doing is providing a channel for communication, a sort of translation of language, between the user and the data. As the ‘interactivity’ category took more shape and volume, it started to become clear that the software is more than just a translator between English and Assembly; it was providing context. That context is being provided by the ability of the system to allow the user to personalise interaction with data in different ways: for example, job orders for the supervisors are in interactive calendar rather than tabulated sheets, KPIs for management are in interactive dashboards rather than statistical figures, and operations for technicians are in functions activated through voice rather than keyed in words. Interactivity doesn’t entail functions necessary for operations; but rather, functions that make work easier, faster, and more user oriented. Users are, in time, creating a more accurate virtual setting complete with the context of changing circumstances; and even as evident in some incidents, user-identity. The significance of interactivity is that it providers context to information by layering data with powerful user and context involvement strategies. It is in this process of layering that knowledge exploitation is being exercised:

Memo sorted in ‘Technological Extension’	one of the recurring themes of calculators is interactivity. Some calculators make it easy/fast/available to collect the information you need from them, while others require that one puts in extra effort. Interactivity is often stressed by higher management: the iphone example

#	INCIDENT	OPEN CODING
425	Upon looking at these examples, I noted that most (not all) operations has two functions: a) the necessary function to get the required work done,	*looking at examples *noting: most operations have 2 functions * function for monitor and control and decision making
426	b) and the function that makes the carrying out of that work easier, faster, more efficient, and more cost effective.	*function for easier monitor and control and decision making
427	So for example:	*giving example
428	Data input can be made by uploading pictures (for example of the faulty wires) and typing it out from handwritten reports while sitting on the desk at the end of the day. (necessary for doing work)	*data input of faulty wires necessary
429	Data input can also be done onsite by using the smartphone application: taking pictures and immediately uploading them and filling out the report by keying it through smartphone. (making work done more efficient and cost effective)	*data input from handheld devices made easier, faster, and more 'live'

#	INCIDENT	OPEN CODING	SELECTIVE CODING
1647	Icons are important – interactive interface is important. "Load issues are not something I want to avoid, I want to fix it." An interactive user interface is not just the visual, but the easier and faster to use. MZ: like my iPhone. "click, click, click get things done".	*icons – interactive interface *load issues because of interactive interface *fix not avoid *interactive interface: visual + easier + faster to use *analogy system with iphone: *click click click	*what is interactivity *third promise
1648	For MZ interactive interface is not a matter of "colorful" or "playing", it's "convenience" easy to use. "He will not look for information, information will look for him"	*interactive interface: not just color or playing, its convenient and easy to use *will not look for information , information will look for him	*what is interactivity *third promise

The core-category 'technological extension' is really a focus on how particular cognitive abilities of project stakeholders are both extended and amplified: extended as in delegated to machines co-dependently, and amplified as in made a hundred times more powerful. The categories, 'system of organisation', 'interactivity', and 'calculation', illustrate how technological extension digitises cognitive and operative faculties of the project stakeholders to build on the guiding, previously established knowledge:

Redundancy – The Third Knowledge Evolving Act

Redundancy was perhaps the most difficult knowing act to theorise partly because the researcher is aware of Nonaka's (1991) concept of redundancy and partly because it is an undesirable practice in a time, scope, and budget bounded project. Nonetheless, redundancy in the digitisation project of XAX was happening frequently enough to become a core category. Nonaka's (1991) notion of redundancy in a knowledge organisation is the "conscious overlapping of company information, business activities, and managerial responsibilities." Basically, it is the same information being circulated to different departments with different objectives. Some departments might need this particular knowledge, some might not need it, and some might not *immediately* need it. The effect is workers from different departments coming together and sharing their various interpretation of that information and how to apply it. This sharing of interpretations creates a common cognitive ground which ultimately internalises new knowledge in the organisation. This 'Nonakian' understanding of the concept of redundancy is different to what the researcher observed about redundancy on the empirical grounds. The early hints of redundancy in the knowledge-evolving project were simply incidents where the same job is being repeatedly done:

Memo sorted in 'Technological Extension'	Replication can come in many forms and for many reasons: knowledge reuse, editing re-editing, reusing same solution, using same interview questions, same demo many times, different FMSP companies, one job by many people, doing job to gain experience, for better focus of project, doing something the same way others did it to learn from them, etc.

#	INCIDENT	OPEN CODING
1115	HN tells me that it's not just my notes, but also other sources. She thinks that because we collected the same data from different sources, we have more knowledge. And the replications we have done (quiet a lot of interviews so far) made a lot of difference in learning new things. We have interviewed 7 software companies with demo sessions + the interviews with the FMPS companies.	*data taken from other sources than research notes *same data from different sources makes better learning/ more knowledge *many interviews: replication of interviewing *two types of interviews: 7 software provider companies and 5 software users companies

As the core category 'redundancy' gathered shape and volume, it was starting to become clear that 'redundancy' includes different ways of being redundant other than repetitions: doing extra work that doesn't seem necessary to the project, using more individuals than necessary to do a task, and doing the same task more than one way. Surprisingly, these extra and supposedly unnecessary tasks uncovered knowledge that was important to the digitisation project. So, while redundancy at face value looks like needless bureaucracy or pointless extra work, it actually leads to amassing and developing essential relevant knowledge. On practical grounds of a project environment, practitioners seem to have a kind of wisdom about redundancy that academics aren't aware of:

Memo sorted in 'REDUNDANCY'	AR is telling me that its natural to face a lot of delays, specially with such a project. He told me that delays happen for many reasons. Things always keep coming up in a project. It was very surprising to me when he suggested that we could take advantage of these delays and use the time. he said we could re-arrange things, collect more information, or become more familiar with the project process. This is interesting as I have never seen anybody who looks positively at project delays.

#	INCIDENT (I#)	OPEN CODING
1568 a	So as long as we are doing “extra work” we are learning something new, and we are documenting what we are learning which means we are moving forward.	*digging more *documenting more

Nonaka’s (1991) explanation of ‘redundancy’ of the *Knowledge-Creating Company* may at first seem to be one and the same as the concept of the core category ‘redundancy’ of the ‘Knowledge-Evolving Project’ discovered in this doctoral study. The difference is not easy to notice but has massive epistemological consequences: Nonaka’s (1991) redundancy is the deliberate *overlapping* of information, business activities, and managerial responsibilities among *different* individuals from *different* departments across the organisation with the ultimate objective of *internalising new knowledge*. The core category ‘redundancy’ in this thesis is the deliberate *adding* of extra steps, processes, procedures, and resources to the *same* teams working on the *same* task with the objective of *amassing specialised knowledge* and better understanding of the project as it emerges. Nonaka’s (1991) redundancy would create an environment of connected information generalised in an epistemological common cognitive ground where individuals could discuss their interpretation according to their separate job objectives, in effect spreading and internalising new knowledge. The redundancy discovered in this doctoral study is a pouring of project resources into a specific task redundantly so more intricate and specialised knowledge is created as the project emerges. Both ‘redundancies’ of the *Knowledge-Creating Company* and the *Knowledge-Evolving Project* involve redundancy in coordination, synergy, and resource allocation; but each is practiced differently to yield different knowledge objectives.

Essentially, redundancy in the knowledge-evolving project is the knowledge evolving act which develops preliminary knowledge or uncovers new knowledge by applying a particular piece of information related to the project to different tasks of scrutiny, investigation, or analysis before officially applying into the project:

Memo sorted in 'REDUNDANCY'	it seems that doing the same job more than once generates new knowledge. this knowledge is presented as experience or lessons learnt
Memo sorted in 'REDUNDANCY'	Redundancy creates focus: knowing more about something for a purpose

The digitisation project in XAX has gone through many redundant coordination and processes as summarised in this memo:

Memo sorted in 'REDUNDANCY'	redundancy by doing a job more than once. Redundancy by using the same solution to different set of problems. Redundancy by editing & re-editing. Redundancy by reusing others solution to solve your problem. Redundancy by doing one job by many people. Redundancy for validation/verification. Redundancy by shuffling same knowledge. redundancy by using same notes for many different purposes. Redundancy motivates reflection, focus, sharing, experience.

Sometime during the investigation of redundancy as a knowledge evolving act, the idea of redundancy as being harmful to the emerging project crossed the researcher's mind. He wondered (memo):

Memo sorted in 'REDUNDANCY'	when does redundancy stop being useful and start being a matter of wasting time and energy?

The answer came a couple of days later during a meeting with operations manager AR: redundancy is useful if it is *intended* and *conscious*. Unintended or unmindful redundancies does more harm than good to a project. There is no one universal rule that defines when purposeful redundancy is enough; it is intuitive to project stakeholders, project environment, and project progress.

Discussion – The Fourth Knowledge Evolving Act

During the first few days of the empirical investigation of the knowing acts in XAX, the researcher developed an interest in examining languaging as a method of knowing. The researcher has long been familiar with postmodern linguistic theories which reason that language is not merely a communication tool but also a mechanism for creating knowledge. The core category 'discussion' was perhaps the easiest to uncover; there are many incidents that confirm the ability of verbal languaging between two or more individuals to conclude with new knowledge created:

Memo sorted in 'DISCUSSION'	When two or more people are engaged in discussion they are not just sharing knowledge, they are creating new knowledge
Memo sorted in 'DISCUSSION'	This I also know from reading a lot about languaging.many thinkers and philosohers consider language not just an act of expression of thought, but also a driver of thought (driver of ideas)

It seems that project management practitioners were aware of this too. There are many recorded incidents which shows that workers often choose to meet and discuss with each other when a difficulty or a problem arise during the project life cycle. Individuals often would leave the meetings with new ideas or better confidence of the issues discussed at hand. On empirical grounds, record shows that discussions are accompanied by flashes of realisation or deduction:

Memo sorted in 'DISCUSSION'	I think the office environment is aware that discussion is not just for decision but also for ideas. Many a times a topic is selected beforehand and decided as the matter to be talked on. A discussion matter. The discussion matter is kept aside for the right time with the right people.

#	INCIDENT (I#)	OPEN CODING
309	This was all before the meeting. After the meeting we had a long discussion (more like an argument), and we finally concluded that any software package could be transformed into another one given that functions get to be modified and functions removed and functions added.	*topic: differences between management softwares. Before and after meeting *discussion/argument *concluded (not agreed): any management software platform can be transformed into another platform
310	We called it 'Expandability' and it was very important to us: the software package we purchase has to be expandable, so that it adapts to the changing scope of the project (Digitization to Facilities Management Company).	*realizing and appreciating: expandability *important: needs to be expandable to adapt to foreseen changes in project scope
353	At this point, HN and I had a major discussion about whether a system can generate more than just reports and excel sheets;	*conversation lead to a different topic *major discussion = can a system generate more than reports and data sheets?
354	perhaps also drawings like flowcharts of a job plan and tree branching of a job structure or progress graphs.	*wondering: generation of drawings? Flowcharts? Progress graphs? Branching charts?
718	This tells us a couple of things:	*our interpretations of the piece *what we learnt from discussion and searching online so far *noting our thoughts down
1286	After a little discussion, we figured out some of the problems with it:	*discussion *figuring out some problems

Solving a problem related to the project by using discussion as a knowing act is actually usually premeditated: what topic to discuss, who are the right individuals to discuss the topic with, what should the order of the subject mattes to discuss be, and even the manner with which to open or steer the conversation are all often planned in advance of the meeting:

#	INCIDENT (I#)	OPEN CODING	SELECTIVE CODING
1596	highlighting what we should talk about with vendors before the demo sessions	*highlighting *what to discuss	*transcriptions *discussion matter
1597	and how are we going to go through it (point by point, which one should we cover first to last).	*how to discuss *point by point – first to last – arranging discussion topics	*discussion matter and ways
1598	HN tells me that we should be very careful and attentive to what we say during the demo sessions when MZ is going to be present.	*opinion: careful and attentive *what we say *MZ will be present	*opinion *planning conversation
1599	Before we ever enter MZ conference room for the [Software Provider 8] demo, we need to sit with the vendor and clarify everything and make sure that the software is perfect to present	*sit with vendor *clarify everything *software is perfect to present	*planning conversation *planning discussion

Memo sorted in 'DISCUSSION'	discussion matter is not only what to discuss, but sometimes also how to discuss it. like which point to talk about first. What to ensure before jumping onto next point etc.
Memo sorted in 'DISCUSSION'	incidents also show that before meeting, conversations are also planned, not just discussions. The difference is philosophical, but I think where the incidents are going, planning discussion matter is more relevant than planning conversation matter
Memo sorted in 'DISCUSSION'	Incidents show that it is often that discussions turn coversation topics. It takes you from one subject to a new subject - from one idea to a new idea - without that new subject being planned to dicuss

While it's true that discussions are more effective if they take place face to face, it doesn't mean that they are not effective at all via phone conversation or even email chains. This was most clear during qualitative document analysis which studied discussions taking place as email chains resulted in new ideas or realisations:

Core Category	Document(s) Selected	Data Analysed
Discussion	D2, D5, D10, D15, D17, D18, D28, D38, D42, D47, D55	These email chains clearly contain discussions about the project requirements, system capabilities, agreement options, and other such various project matters. Within one email chain, one can observe that as discussion progress, new ideas are being brought up.

Sometime during the later stages of studying ‘discussion’ as a knowing act, the researcher wondered between the difference of discussion for conviction of opinion and discussion for exploring new ideas; both of which were ostensible in incidents taking place. The researcher then came across Peter Senge’s (1990) *The Fifth Discipline* which immediately cleared this doubt. Senge (1990) distinguishes between ‘discussion’ and ‘dialogue’; both an essential practice of the five habits of the learning organisations. To Senge (1990), where ‘discussion’ is the presenting of opposing views in a debate of conviction, ‘dialogue’ is the conversation exploring new concepts and ideas. Both ‘discussion’ and ‘dialogue’ tend to co-create rather than simply communicate knowledge among individuals within a process of generative learning. The distinction between ‘discussion’ and ‘dialogue’ in this doctoral thesis is made at the category level, but later at the core-category level is overlooked and simply referred to as ‘discussion’. There are two reasons for this: first, unless one is an experienced linguist, it is difficult to tell ‘discussion’ and ‘dialogue’ apart in a real-life conversation. They often happen together in a mix of different modes of rhetoric. Secondly, this doctoral research is interested in knowledge evolving (exploitation) acts, and according to Senge (1990) it is ‘discussion’ when co-creating knowledge occurs using opposing point of views as the base guiding knowledge. Either way, the knowledge evolving act – discussion – is not defined as per the distinction made between ‘discussion’ and ‘dialogue’, but rather as the resultant aggregation of both language modes that occur in real life:

Core Category	Category	Properties
Discussion	Discussion & Dialogue (D&D)	there are many instances of reasoning/concluding/ deducing / sense making/ infer / realize during D&D
		D& D are languaging tools that intends to acquire knowledge that is out of realization and/or awareness
		D&D rarely occur as separate conversational events
		"D&D often end up not only in coming up with new concepts, but also giving terms/definitions to these new concepts.

Summary

The success of discovering, saturating, and triangulating the four knowledge evolving acts – Inscription, Technological Extension, Redundancy, & Discussion – from the empirical grounds of the digitisation project of XAX is attributed first to the philosophical, theoretical, and practical orientation in 'Literature Review' chapter, and second, to the research design and implementation procedures from the 'Methodology' chapter. Inscription is a cycle of documentation that starts from rough noting to final project official texts, and back as reference to rough noting to produce new official texts. Technological Extension is the use of computer technology to amplify the ability of project stakeholders to interact with data to develop and build on pre-determined project knowledge. Redundancy is the deliberate adding of extra steps, processes, procedures, and resources to the same teams working on the same task with the objective of amassing specialised knowledge and better understanding of the project as it emerges. Discussion is the use of languaging skills between project stakeholders to argue a point or introduce a new idea on a particular subject matter in effect causing new realisations that were not apprehended before. The next chapter will introduce the FRDA model and discuss how these knowledge evolving acts bring about the FRDA knowledge processes.

CHAPTER FIVE: DISCUSSION

5.1 Knowing Acts of the Knowledge-Evolving Project

"*Its's funny what's happened to this word knowing… The actual act of apprehending, of making sense, of putting together, from what you have, the significance of where you are – this [now] oddly lacks any really reliable, commonly used verb in our language… [one] meaning the activity of knowing. … [Yet], every culture has not only its own set body of knowledge, but its own ways of [knowing]*." With this excerpt by Sir Geoffrey Vickers, Cook & Brown (1999) open their journal study – *Bridging Epistemologies: The Generative Dance between Organisational Knowledge and Organisational Knowing* – by inviting us to think about the actual practices by which knowing is being exercised in organisations. Cook & Brown (1999) were not the first organisational management scholars to observe the application differences between knowledge possessed (epistemology of possession) and knowledge practiced (epistemology of practice), but the distinction they made between 'knowledge' and 'knowing' was both pragmatic and realistic to management practitioners and academics. This was important to furthering Nonaka & Takeuchi's (1995) book which could only explain the difference in a fiery blend of often contradictory philosophical statements.

Put simply, 'knowledge possessed' is what is already known, and 'knowing practiced' is what is in the process of being known. Although Cook & Brown (1999) made a clear and pragmatic distinction between 'knowledge' and 'knowing', their explanation of 'knowing' constituted of theoretical and philosophical blending of concepts that mix 'posteriori knowing' and 'knowing acts'. This is evident in the many ways 'knowing' is described: a) epistemic work done by the human action itself, b) knowledge as part of action, c) knowledge as a tool of knowing the unknown, d) pragmatism and interaction between knowledge sources, and e) learning by experience than by dictation. In any case, Cook & Brown's (1999) comprehensive and undiscriminating review of knowing acts reveal the significance of knowledge management studies that experiment with framing knowing acts (rather than knowledge forms) as knowledge dimensions. One such study is Mingers (2008) who proposed four dimensions of knowledge: propositional, experiential, performative, and epistemological; each rooted to specific knowing acts they entail. Similarly, Scharmer (2000) proposed four dialogue types based on the language game entailed by the knowing acts: talking nice, talking tough, reflective dialogue, and generative dialogue. Knowledge dimensions defined based on knowing actions (such as procedural, declarative, know-what, know-how etc.) rather than knowledge forms have been present since before Cook & Brown (1999). In retrospect, the whole premise of dividing knowledge dimensions based on knowledge form vs. knowing action is as old as Plato's 'justified true belief' vs. Aristotle's *Epistémé* (discursive factual knowledge), *Téchné* (action oriented knowledge based on skills), *Phrónésis* (practical wisdom based on experience), *Sophía* (scientific knowing), and *Noûs* (intuition). Intriguingly, Amin & Roberts (2008) managed to organise both knowledge forms and knowing acts across each other in one table in a fascinating attempt to study 'knowing in action'.

There is no direct formal definition of 'knowledge acts' in management scholarly publications aside from Cook & Brown's (1999) 'epistemology of practice'. This research thesis – inspired by the general review of knowing acts in the 'Literature Review' chapter and by the empirical investigation of knowledge evolving acts in the 'Results' chapter – formally defines 'knowing acts' as the various knowledge practices that are exercised to attain a specific objective of knowing. These include languaging techniques (e.g. argumentation, narration, and metaphor), social interaction techniques (e.g. imitation, water cooler talk, and communities of practice), epistemological access techniques (e.g. reading, writing, and watching videos), and praxis techniques (e.g. observation, reflection, and experience). Knowing acts are the *de facto* real-life practices that fulfill the *de jure* objectives of knowledge processes. So for example, at face value, the knowledge process ‘codification’ is taken as the collection, compression, and storage of knowledge. However, collection, compression, and storage of knowledge include various approaches of knowing acts such as searching, reading, summarising, and validating. Likewise, the knowledge process ‘knowledge retrieval’ is not just a mechanical search and find effort; it involves intuition, sense-making, and awareness of the easier faster path. Knowledge retrieval requires that information be chosen, distilled, and focused to address the issue at hand. Knowledge dissemination, knowledge integration, knowledge storage etc., and all the rest of knowledge processes can be similarly identified; they are the ontologically based (communicative and taxonomic) de jure (exists by ruling) objectives of the inevitably involved epistemologically based (comprehensive and creative) real life de facto (exists by fact) practices of knowing.

It is indeed because considerable academic and practitioner focus is given to knowing acts that this discipline is called ‘knowledge management’ rather than ‘information management’. Placing knowing acts as the foundations to knowledge management is just another way to see why knowledge management is really about managing the knowers instead of managing knowledge itself. The results obtained from the empirical study – inscription, technological extension, discussion, and redundancy – are all *knower centered* management approaches of the project knowledge management. The emphasis on knowledge or information itself comes only when considering the epistemic influence it has on the knowers. The majority of the focus is consumed on observing knowers who exercise knowing to evolve their intelligence and develop the information predefined at the outset of the project: *inscription* is exercised by knowers who cycle through documentations as they go from rough noting to final versions and back as reference to rough noting; *technological extension* is an activity exercised by knowers to extend their knowing dexterities to artificial intelligence digital technologies; *discussion* is a languaging activity exercised by knowers to argue a point or introduce a new idea to the project; and finally, *redundancy* is when knowers deliberately apply a particular piece of information related to the project to several different tasks of scrutiny, investigation, or analysis. But what does it exactly mean to manage the knowers who exercise knowledge evolving acts? How is it precisely done? To understand that, it is first important to investigate how different knowledge evolving processes influence the dynamics with which knowledge evolving spiral flows within a project context. The final section following the next will then be ready to introduce the FRDA model which describes exactly what it means to manage the knowledge evolving knowers.

5.2 Knowledge Processes of the Knowledge-Evolving Project

Knowledge management processes in the context of project knowledge management are heavily based on organisational knowledge management processes. This is most evident in the terminologies used; standard organisational knowledge management processes such as identification, acquisition, sharing, dissemination, codification, and application etc. are directly adopted and applied into project knowledge management (Handzic & Bassi 2017; Gasik 2011; Koskinen & Pihlanto 2008). In fact, Mishra & Bhaskar (2011) suggest that there can be only so much knowledge management processes. In today's appreciation and implication of the project-organisation and the organisation-project, there are certainly no shortcomings or deficiencies of the direct assumption of standard knowledge management processes from organisations to projects. Nonetheless, the concept and nomenclature of the same knowledge management process can be calibrated to fit the knowledge exploitation policy of a classical project ontology rather than an explorative one pertaining to organisation ontology. Furthermore the order of flow by which the knowledge processes are arranged can be made exclusive to project knowledge management by associating them with the characteristic classical project management project's processes from initiation to closing. The appropriation of particular knowledge management processes in a manner that fits the knowledge-evolving project is only made possible by the philosophical, theoretical, and practical insights in Chapter Two (Literature Review) and the empirical discovery of knowledge evolving acts in Chapter Four (Results).

Given that 1) projects are initiated by the whole institution rather than the individual, 2) all knowledge *essential* for project completion is formed, decided on, and authorised in the opening of the project, 3) the ongoing project uses the outset knowledge to develop, mature, and progress as the knowledge exploitative efforts overtakes the knowledge explorative one, 4) generalised knowledge approved and distributed to stakeholders at the beginning of the project transforms into specialised knowledge as each project worker completes their task, and 5) knowledge management in projects should induce stability by overcoming anticipated and unforeseen potential problems and opportunities, the knowledge evolving processes of the knowledge-evolving project are:

1. <u>Knowledge Formalisation</u>: The process of collecting, codifying, and authorisation of the full knowledge necessary and essential – project based and product based – to *formally* and officially initiate the project. This knowledge is recorded in managerial process-based documents such as the work breakdown structure, communication matrix, and risk management register; and technical-based or product-based documents such as material requirements, machinery use manuals, safety instructions, and experimentation procedures. Formalisation ideally occurs at project initiation.

2. Knowledge Realisation: The process of application, implementation, and execution of the established formalised knowledge into the real-world project as it emerges. It is at this stage the project workers come to face the predicted and/or unanticipated problems and opportunities. By experiencing an abstract a priori knowledge of a project into a posteriori real life implementation, a new reality of the project is *realised*.

3. Knowledge Deconstruction: The newly realised reality of implementation difficulties and opportunities give project workers the incentive to *deconstruct* and changed the knowledge defined at the project outset rather than generate fundamentally different knowledge. The knowledge deconstruction process is where knowledge becomes most specialised to the project worker. Consider this scenario for example: a project with the objective of installing a building management system (BMS) would have several teams with different expertise working on different parts of the project simultaneously. Suppose that the team responsible for installing heat sensors received a notice from the government that the fire detection standards of buildings have changed. To adhere with the new government regulation, the team responsible for installing sensors would have to redesign the sensor circuitry so that the new heat sensors can be integrated. The engineering art and skills necessary for redesigning the circuits is a dialogue that where one extra-genetic intelligence enhances the other.

4. Knowledge Assimilation: The accretion of newly deconstructed knowledge and the restructuring of previously established project knowledge entail a process of simultaneously unlearning the now inadequate knowledge and integrating it with the restructured prevailing knowledge. Consider the BMS scenario again. The newly redesigned circuitry is authorized and made public knowledge for project stake holders.

> The programming team realized that the new circuitry requires some changes in the main programming platform. Similarly, the team responsible for the budget plan realize that they need to contract an electronics manufacturing factory to produce the new electronic chips. Once all these alterations and changes have been made, the common knowledge base of the project stakeholders gets modernized and updated. The newly assimilated project knowledge is now ready to pass through another cycle of knowledge evolution.

As previously discussed, the fit between the project's life cycle and the knowledge evolving processes is idealistic because in reality the life cycle of a project runs through overlapping interactions of initiation, planning, execution, monitoring and control, and closure, with the dominance of named processes respectively at each stage. Ideally, knowledge formalisation occurs at project initiation and planning, knowledge realisation at project implementation, and knowledge deconstruction and assimilation at monitor and control and planning. The knowledge evolving processes of the knowledge-evolving project have now been identified; and with that, the knowledge-evolving project model is finally ready to be addressed.

5.3 The Knowledge-Evolving Project Model

The knowledge-evolving processes were speculatively inferred based on the theoretical, philosophical, practical, and empirical insights of the knowledge-evolving project. They have no solid observational or experimental weight of themselves since the empirical research was directed at investigating knowing acts and not knowledge processes. As such, the thesis study has barely scratched their surface. However, that was the intention of the researcher; to invite the project management community, especially those interested in knowledge management in projects, to rethink the conventional wisdom of managing standard project knowledge management processes (such as knowledge capture, assimilation, codification, transfer, and application) based on the proposed nomenclature behind the concept of the processes. There are two ways with which managing four knowledge processes of the knowledge-evolving project are open for interpretation: 1. the theory behind and the mechanisms of the sub-processes that constitute each of the four knowledge processes, and 2. the understanding that each of these processes and sub-processes can potentially be entirely accomplished by artificial intelligence without human intervention.

There is another reason why the knowledge-evolving processes were inferred rather than simply left for further research. The processes of the knowledge-creating company are intended to transform one form of knowledge to the next: socialisation transforms from tacit to tacit, externalisation transforms from tacit to explicit, combination transforms from explicit to explicit, and internalisation transforms from explicit to tacit. The key word that describes the mechanism of these knowledge management processes is *transformation* (or *conversion*). The knowledge processes of the knowledge-evolving project do not transform intelligence from one form to the other; but rather *utilise* one form to *enhance* the ability of the other. Recall in the literature review in Chapter 2 when it was discussed that the differences in the superiority between the two intelligences, mechanical and natural, can be used to complement and complete each other rather than compete and contrast. It is precisely the knowledge evolving processes that does this complement and completion between the two intelligence types; and it is done differently at different stages depending on what type of intelligence is enhancing what other type. For the project management practitioner and the project knowledge management scholar, this is exactly where the management aspect of managing knowers comes (Figure 5.1):

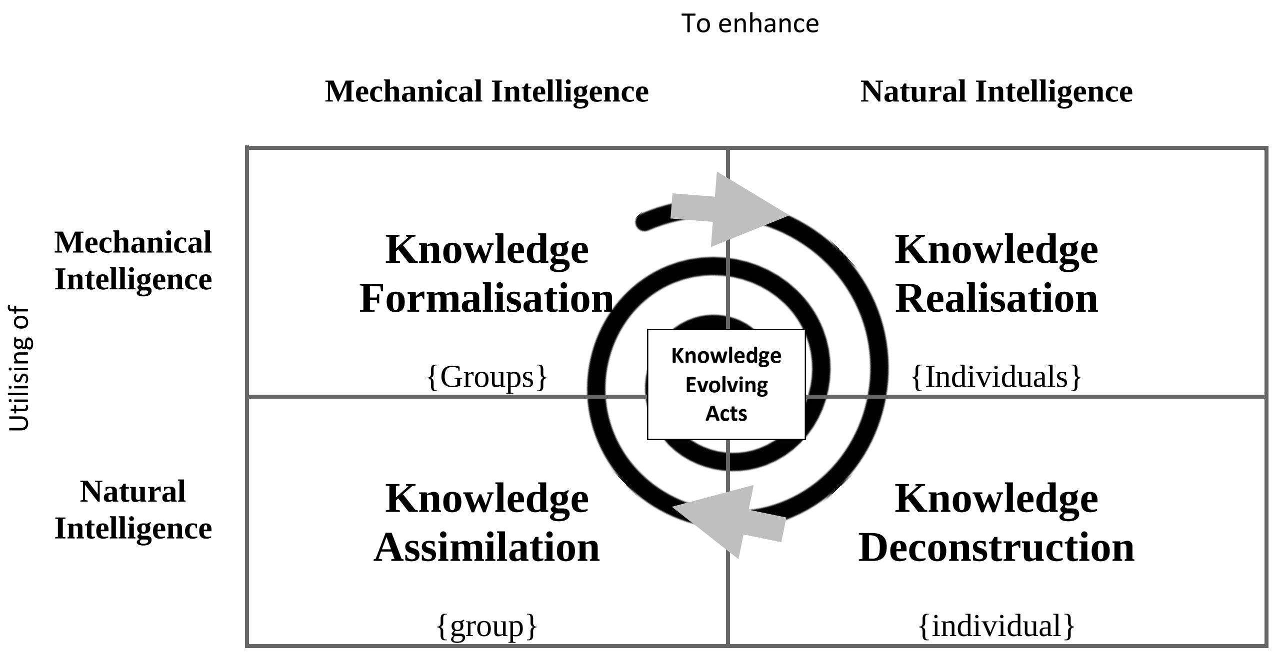

Figure 5.1: The Knowledge-Evolving Project Full Model

Figure (5.1) is the final model that illustrates the most basic foundations and fundamentals of project knowledge management as reinvented under the name the 'knowledge-evolving project'. Note how the four 'knowledge evolving acts' do not correspond to any specific knowledge evolving process; this is because they were observed occurring simultaneously and continuously throughout the empirical study of the digitisation project of XAX with no particular knowing act being dominant at a particular knowledge process. This means that one can exercise any of the knowledge evolving acts to attain the different objective of knowledge required by each of the knowledge evolving processes. Note also how the model consists of everything discussed in this thesis: 1. the knowledge evolving spiral that spirals inwards towards project discovery and emergence 2. the knowledge evolving acts that drive the spiral, 3. the forms of intelligences as they are being utilised to enhance the other, 4. the knowledge evolving processes that sets an objective of knowing, and 5. the engagement dimensions of stakeholders. The following takes us through the blocks one by one to explain the model in greater details:

1. <u>Mechanical to mechanical intelligence</u>: At this stage all the different *groups* of stakeholders – investors, project teams, contractors, project managers etc. – are engaged in collecting, codifying, and authorising the complete project knowledge into a full and official project charter. The process of pooling codified knowledge from different sources and classes of stakeholders into major project charters means that mechanical intelligence is being utilised to enhance itself: from the creation of digital and physical documentation by one group of stakeholders, to the augmentation of all digital and physical documentation of the project, mechanical intelligence is being used to enhance and combine the separate pieces of knowledge that exists within the mechanical intelligence of computers and papers. The

mechanical intelligences being utilised and enhanced do not just have a superior facility of storage; there is also the superior speed of sharing, the superior objectiveness in recall, and the superior ability of information processing. The process to utilise mechanical intelligence to enhance further mechanical intelligence is neither fully independent from the knowers nor wholly a part of them; but rather, an externalisation of particular cognitive abilities from different groups coming together for the project as a whole.

2. Mechanical intelligence to natural intelligence: At this stage, the different teams consisting of *individuals* responsible for various specific portions of the project begin to apply the knowledge formalised at the first stage. Here, they are using the mechanical intelligence of the digital or physical documents to guide them in understanding and rationalising what is happening in the real world as the project slowly emerges. The mechanical intelligence of papers and devices is limited and can only be utilised to support the individuals so much. The individuals in their teams need to take advantage of the support of the mechanical intelligence to boost their natural intelligence – which is superior in interpretation, intuition, realisation, and sense-making – and ultimately understand the gap between knowledge defined at the outset and reality of the project unfolding.

3. Natural intelligence to natural intelligence: The intelligence effort for recognising and comprehending the gap between knowledge at the project outset and reality of the project is usually a collective effort because what is being observed is common between the observers. But the problem-solving, creative out-of-box thinking, and original innovative

insights are highly subjective and personal to the single *individual*. The observation and interpretation of collective natural intelligence enhances the cognitive ability of the individual's natural intelligence. The unique and different abilities of each individual to interpret, comprehend, and think about the issue is amplified here. That deconstruction of established project knowledge to take advantage of opportunities or control the problems arising is ultimately an ability exclusive to the individual thinking mind.

4. <u>Natural intelligence to mechanical intelligence</u>: the knowledge deconstructed by natural intelligence is now in the process of being collected and assimilated into the mechanical intelligence of computers and papers. This job is often done by the *group* which consist of the individual(s) who applied the deconstruction. It is in this process that unlearning of inadequate knowledge and accreting on the remaining relevant knowledge that natural intelligence is being utilised to enhance mechanical intelligence. The enhancement of mechanical intelligence is not just in the amount of knowledge being assimilated, but also in the modification and restructuring of information and their functions consequently.

For every cycle of the FRDA model (formalisation, realisation, deconstruction, and assimilation), knowledge is not just evolving in the sense of being assimilated and restructured, but also in the sense of *guidance*. Recall that the project knowledge officialised at every formalisation iteration provides the course and plan of action and the direction towards what to assimilate next. In knowledge philosophy this phenomenon is called epistemic relativism: the notion that what is known will affect what one choses to know next and how one comes to know it (Luper 2004). By reason it thus comes to mind that at every knowledge-evolving iteration, it’s not just knowledge being evolved, but also, indeed, intelligence – the ability to create, assimilate, accumulate, and manipulate knowledge. The connection between knowledge and intelligence demonstrated in the model also solves the problem of ‘knowledge externalised’. Knowledge in the model does not jump from one plane of reality to another; it exists as a consequence of the presence of the intelligence of memory.

CHAPTER SIX: CONCLUSION

6.1 Reinventing the Foundation of Project Knowledge Management

The focus of investigation in the doctoral thesis effectively began when the researcher first realised that the knowledge spiral of Nonaka & Takeuchi's (1995) *Knowledge-Creating Company* could not be applied to project knowledge management. It wasn't difficult to note that there are several theoretical discrepancies evident between the epistemic mechanism of Nonaka & Takeuchi's (1995) knowledge spiral and the epistemic mechanism of knowledge flow within project environments. During that period the researcher was also of the opinion that the knowledge spiral is primarily propelled by knowledge processes. However, he later recognised on empirical grounds, that which is observed to be driving the knowledge spiral is not the knowledge processes, but rather the knowing acts. In fact, both the knowledge processes and the knowing acts propel the knowledge spiral; the knowledge processes constitute an objective for knowing, and the knowing acts carry them out. From that point on, the doctoral research pivoted around the knowing acts of project knowledge management – what they are, how are they practiced, and how they drive the knowledge spiral in a project context?

Empirically investigating the knowing acts without prior reading of the literature is important for genuinely discovering a theory that is grounded in data (Glaser 1992). Nonetheless, being open minded in the empirical field is different from being empty minded. The researcher had to equip himself with a solid philosophical, theoretical, and practical orientation and a justification and rationale for specifically researching knowledge exploitation practices before going into the empirical field, otherwise he would have circled around aimlessly, or worse, lost sight of the objective of the study. It is precisely these philosophical, theoretical, and practical orientations that guided the researcher into deconstructing the deep roots of organisational knowledge management from project knowledge management, and thus reinventing the foundation of knowledge management in projects. That is how the journey of exploration for this doctoral thesis took a thrilling turn; what started off as a research study for investigating knowing acts in projects, became a research investigation for reinterpreting the foundations and fundamentals of a full discipline of project knowledge management; appropriately called the ‘knowledge-evolving project’ to emphasis the point that it is the opposite of Nonaka’s (1991) ‘knowledge-creating company’.

The discovery and interpretation of the ‘knowledge-evolving project’ has made six original contributions, which were framed as objectives and main aims in the introductory Chapter One in Section 1.6. The first contribution directs attention towards a matter that was hardly addressed in literary publications; that project knowledge management is in its roots an organisational management study and therefore not idiosyncratic to project management’s unique identity and characteristics. This opens the door for the next three original contributions; to decouple project knowledge management from organisational knowledge management first philosophically, second theoretically, and third practically. For each of the three foundational pillars of the ‘knowledge-evolving project’ – philosophy, theory, and practice – there lies insights waiting to be revealed. First, philosophically, the thesis introduces Sagan’s ‘evolution of intelligence’ as the philosophical backbone to the knowledge-evolving project as opposed to the more complex and less pragmatic Polanyi’s (1958) ‘tacit knowing’. What was a matter of transforming one form of knowledge to another (explicit to tacit and back) *is instead a utilisation of one type of intelligence to enhance another* (mechanical and natural). Second, theoretically, according to the unique identity and characteristics of project management as defined by PMI (2013), projects should use knowledge to meet constraints efficiently and effectively rather than outgrow them. This means *that* *knowledge exploitation is overtaking knowledge exploration in project environments*. Third, practically, the knowing acts and knowledge processes involved in the knowledge-evolving project *are characteristically largely epistemically relative*; the predefined knowledge does not sit there patiently waiting to be developed, it actively guides the knowers in how to next evolve it. With these three orientations and justifications, the researcher walked into the empirical field to explore the knowledge-evolving acts as they occur in a project context. The knowledge-evolving acts uncovered – *inscription*, *technological extension*, *redundancy*, and *discussion* – is the fifth original contribution this doctoral thesis makes. The sixth contribution is the assimilation of the orientation of the 'knowledge-evolving project' with empirically uncovered knowledge-evolving acts to construct *the FRDA model*, which is essentially the management model of the 'knowledge-evolving project'.

The six original contributions are distributed across four chapters: Literature Review, Methodology, Results, and Discussion. Chapter Two (Literature Review) is concerned with deconstructing organisational knowledge management from project knowledge management and reinventing a foundation of knowledge management idiosyncratic to project environments. It covers the first four original contributions made by this doctoral thesis. The effort here mostly involved philosophical, theoretical, and practical reasoning and dialogue. Chapter Two in effect provided the rationale and justification for the empirical study of knowledge exploitation acts in project context reported in Chapters Three and Four. Chapter Three (Research Design & Methodology) presented an original research and methodological design consisting of three layers to conduct the empirical study. The layers, in order, are: *pragmatism*, *qualitative-inductive-explorative*, and *Glaserian Grounded Theory for saturation* and *Qualitative Document Analysis for triangulation*. Chapter Four (Results) covers the fifth original contribution of the thesis study.

The saturated triangulated results presented and discussed are *inscription, technological extension, discussion*, and *redundancy*; each a unique knowledge practice exercised to evolve the knowledge predefined at the initiation and planning phase of the project. *Inscription* is a cycle of documentation that starts from rough noting to final project official texts, and back as reference to rough noting to produce new official texts. *Technological Extension* is the use of computer technology to amplify the ability of project stakeholders to interact with data to develop and build on pre-determined project knowledge. *Redundancy* is the deliberate adding of extra steps, processes, procedures, and resources to the same teams working on the same task with the objective of amassing specialised knowledge and better understanding of the project as it emerges. *Discussion* is the use of languaging skills between project stakeholders to argue a point or introduce a new idea on a particular subject matter in effect causing new realisations that were not apprehended before. These results of Chapter Four of the empirical research designed in Chapter Three are augmented with the Literature Review of Chapter Two to explain and discuss what it actually and precisely means to manage the knowledge-evolving project in one model; the FRDA model. The final FRDA model is the sixth and final contribution the study makes. The model does not just establish the knowledge evolving acts of the knowledge-evolving project; but also presents the whole of the knowledge-evolving project and how to manage it.

6.2 Limitations & Further Research

One of the major features of this doctoral thesis is its high level of generalisation. The knowledge-evolving project is a concept that applies to the knowledge management of projects operating in the traditional PMBoK sense. To achieve that, the doctoral thesis first had to investigate the organisational ontology and classical ontology of projects and project management to determine the point where projects and organisations crossed paths to become a hybrid institution, and henceforth to deconstruct the deeply rooted connection between organisational knowledge management and project knowledge management. This ultimately produced an orientation which guided the researcher to investigate and reinvent the foundation and fundamentals of knowledge management in project management at the most basic level. The high level of generalisation does not only establish project knowledge management at its most fundamental state, but it also allows for as much intellectual space for reinterpretation as possible. The FRDA model is more ideal than realistic and is thus readily open to reinterpretation to the various dimensions and classes of different project types, such as construction, manufacturing, business re-modelling, and research and development (Besner & Hobbs 2012; Sadeh, Dvir & Malach-Pines 2006).

Throughout the thesis (particularly the literature review of Chapter 2), from navigating across the different project management and knowledge management eras to investigating the various theories of knowledge and management of knowledge, and finally on to exploring the knowing acts of project management in project context, the high level of generalisation is easily the most discernable limitation. The volume and expanse of various terminologies used from across the philosophy of knowledge, knowledge management theories, and characterisations of project management ontologies all speak of the highly explorative nature of the study. Such a high level of exploration ultimately requires the researcher to pass through so many concepts without really pausing long enough to investigate further – one thesis study cannot be enough to cover the full reinvention of a project knowledge management discipline. What this study does is place the first cornerstone in doing so; a simple and basic understanding of exploitative knowing overtaking explorative knowing in a traditional modernist characterisation of project management.

This limitation is also interestingly a strength of the thesis. The knowledge-evolving project model, with all the generalisations it makes, is a simple and practical one. Because the model is ideal and applies to any project context, it is easy to adopt by the wide array of the project management community. All it really takes is for people to familiarise themselves with the terminologies. The FRDA model of the project knowledge management is even simpler than the SECI model of organisational knowledge management. Unlike SECI, FRDA does not require the scholar or the practitioner to deal with externalisation or internalisation of any magical dimension of knowledge; it simply demonstrates how in the process of utilising one type of intelligence to enhance the other, knowledge is being created, applied, deconstructed, and developed.

On the other hand, unlike the FRDA model, particular knowing acts of the SECI model are constrained to particular knowledge process being carried out. This level of boundedness and simplicity was not observed during the empirical research when the digitisation project was unfolding. It seemed that all the knowing acts were continuously and simultaneously happening regardless of the knowledge processes being implemented. But then again one can argue that the empirical research did not cover the full project life cycle. The phases recorded and analysed in the empirical stage were the definition and initiation, selection and planning, and pre-implementation. Perhaps if the full project life cycle was empirically investigated, particular knowing acts could be observed to be dominant over the others during a particular phase of the project. The researcher ceased data recording and analysis after almost six months because he had to balance obtaining study results with achieving specific deadlines of the PhD process. Once the results were obtained and triangulated, it was time for the thesis to written up.

Nonetheless this did not stop the researcher from unofficially continuing the observation in the empirical field during the write-up of the thesis write up. As the project cycled through implementation, testing, and monitoring and control, there seemed to be no definite categorisation for knowing acts under knowledge processes. Discussion and dialogue, technical extension, inscription, and redundancy were taking place simultaneously and at all times between the project stakeholders. Yet something else surprising did surface during this period of unofficial unrecorded observation; a new knowledge evolving act. The first hint to this knowing act appeared during contract signing. The operations manager, the head of finance, the IT consultant, and the researcher/maintenance engineer were briefing the managing director about the content of the contract in details before getting his final approval signature. A discussion about the method of implementation was taking place, when the managing director recalled a conversation he had with one of the vendors about migration of data. A thought seemed to have unexpectedly crossed his mind. The managing director then asked the IT consultant if it is possible to extract the data and store it in a state of 'opened format' which would allow it to be easily integrated into any system other than the one where it is being migrated to. The IT consultant said that that was possible, and hereafter this changed was included into the contract. The researcher initially thought that the knowing act that excited this idea was discussion; but the managing director was not engaged in discussion with the project committee during that incident. He was looking upwards deep in thought; and he was thinking about something different than what was being discussed. He then announced that he was remembering the conversation about data migration which gave him the idea to 'open the data'. This knowledge evolving act is the unofficial fifth: Recollection. Recalling or remembering is not merely an act of replaying or rerunning a thought; there is a fair level of reconstruction and knowledge creation happening in the mind of the person remembering. Assimilation or development of the knowledge being recollected is unexpectedly also taking place. In the events that followed, the researcher was directing most of his attention towards incidents where the knowing act of recollection or remembering was taking place. There were several more; but perhaps not as often as the other officially recorded four knowledge evolving acts.

The FRDA model of the knowledge-evolving project is a project knowledge management model constructed based on the body of knowledge and set of laws that constitute a traditional classical ontology of projects and project management. What would be interesting to see in further research is a study that would explore the different ways by which the FRDA model of knowledge-evolving project is *superimposed* with the SECI model of the knowledge-creating company. The method and manner with which the superimposition is applied would depend on the subject matter being investigated; FRDA and SECI could be superimposed in series, in parallel, or even as a decision-making tree. This would perhaps reveal a peculiar state of knowledge ambidexterity to project-organisation hybrids never recognised before. Another interesting route that further research may take is by building the FRDA model upon a configuration of agile project management (Serrador & Pinto 2015; Wysocki 2014; Saynisch 2010). What would knowledge management principles and practices look like then? Either way, moving towards a complete knowledge management theory exclusive to the project management discipline has just begun. There is still much to be explored and studied.

6.3 A Researcher's Personal Reflection of the Study

The routes and pathways this research has taken and the results it has yielded was not like anything the researcher had expected or foreseen. This is one of the fascinating things about doing a PhD study; at every turn there is a eureka moment waiting to jump out and reveal itself, and with every eureka moment comes a new path. The researcher had started his PhD concentrating on investigating the possibility of 'linguistic intelligence' and 'language management' in project management, because although he is an electrical engineer by background, he was very passionate about an area of study he had discovered – Linguistics. The researcher was absolutely fascinated by Whorf's (1956) hypothesis of 'linguistic relativity', which essentially stated that the language someone uses affects the way they come to think and view the world around them. The researcher thought that somewhere somehow, there is a gap in literature where linguistic intelligence can be defined in terms of linguistic relativity, and all in the context of some field of language management in project management. The idea and all the effort that came into investigating and researching it came to an end sometime after the second year of the PhD study for several obvious reasons: one, the researcher is not a linguist by profession and had only recently been introduced to linguistics. Conducting an empirical study would have at the very least required a very particular set of knowledge skills that are based in the field of psychology of language. Two, language studies in the sense of ‘linguistic intelligence’ has no real presence in the field of project management, and it was impossible to determine or envisage the practical applications it might offer to project management. The proposal was highly philosophical and barely touching on some theoretical framework. Three, relying on knowledge management as a conduit for ‘language management’ to enter the field of project management made it exactly as theoretically dense and complex as this sentence sounds. It was a very difficult decision that the researcher had to make when he dropped linguistics; he knew he wouldn’t be able to fulfill the PhD requirements successfully. This, of course, doesn’t mean that such an investigation is not possible; but rather, the researcher wasn’t ready to take on such a huge and multifaceted psychological-based study given that he is after all merely a novice researcher.

During the two years while working on ‘linguistic intelligence’, the researcher became very well acquainted with the field of knowledge management, and was growing curious about the idea of intelligence in project knowledge management. He was convinced of the notion that language and knowledge are two sides of the same coin which he envisioned to be ‘the intelligence coin’. So he started searching for a knowledge theory that is equivalent to linguistic relativism, and not before long, he found epistemic relativism. The ‘intelligence coin’ is now epistemic relativism on one side, and linguistic relativism on the other. When the researcher attempted on a separate occasion to superimpose the SECI model on the project lifecycle, the ultimate eureka moment dawned on him: knowledge management, theory of intelligence, epistemic relativism, and knowledge ambidexterity in the project life cycle all came together into one messy bowl of mixed ideas. This doctoral thesis is the processed product of this messy bowl.

Perhaps among all the difficult tasks that the researcher has faced, the most difficult one was the task of simplification. This is not something that usually faces PhD students, but readers can certainly see for themselves the size of the exploration this doctoral study tackles. It spans across an extensively wide array of topics and subject matters. The research thus involves much theoretical, philosophical, and technical concepts and terminologies drawn from different fields of studies that consider the topic under discussion. Bringing all these concepts together into a simple and straight reader friendly thesis took most of the energy and time from the researcher.

If the researcher had to pick the favourite thing he took away with him from doing a PhD, it would definitely be *philosophy*. Among all the different pieces and phases of the PhD journey, philosophy has been the most thrilling and exhilarating to engage with. Prior to doing a PhD, the research had little to no real knowledge on what philosophy is and how it works given that he comes from a solid scientific background of natural sciences in schools and later electrical engineering in bachelors. The researcher here would finally like to take the opportunity to perform a philosophical diagnosis of why linguistics failed and epistemology worked in his PhD journey; because linguistics, along with ethics and aesthetics, leans more towards continental philosophy, while epistemology, along with ontology and logic leans more towards analytical philosophy. The researcher invites the reader to silently muse on this thought.

Glossary

Classical Ontology of Projects: is a term designated to invoke project and project management as interpreted and defined by project management professional societies and bodies of knowledge such as the APM and the PMI. The position taken by these societies interpret project and project management in a way that makes it unique from other institutions. These interpretations include concepts such as: project temporality, the triple constraints of scope, budget, and time, and the project life cycle.

Entative paradigm of knowledge (Epistemology of Possession): is a philosophical understanding of knowledge that allows it to be in a constant state of being – relatively stationary and static. Entative knowledge can exist in different forms of being depending on its ontological position, for example 'embedded' in technology, 'tacit' in individuals, 'encultured' in groups, and 'explicit' in documents. The entative epistemology faces a philosophical difficulty with knowledge externalisation since its main premise is that knowledge cannot be independent from the knower.

Epistemic relativism: the philosophical notion that what is known will influence what one choses to know next and how one comes to know it.

Epistemology: is the philosophical study of knowledge and a major branch of philosophy. Epistemology asks questions such as 'what is knowledge?', 'how can knowing be attained?', 'where does knowledge exist?'

Evolution of intelligence: is a scientific study by popular cosmologist and astrophysicist Carl Sagan which explores the evolution of intelligence from when it first appeared 3.8 billion years ago to a future where artificial intelligence is thriving independently and autonomously from its biological ancestors. Evolution of intelligence rests upon the merits of the highly controversial theory of evolution by Charles Darwin.

Extra-genetic (Natural) intelligence: is the knowledge and knowing capabilities of the human brain that evolved when the human genes could not handle the fast changing growing base of knowledge needed for the human species to survive. Extra-genetic intelligence is a scientific theory of knowledge put forth by Carl Sagan based on the theory of human evolution by Charles Darwin.

Extra-somatic (Mechanical) intelligence: is the knowledge and knowing capabilities of technical artefacts (such as document depositories and technological systems) that evolved when the human brain could not handle the faster changing mounting base of knowledge needed for the human species to dominate. Extra-somatic intelligence is a scientific knowledge theory put forth by Carl Sagan and is based on the theory of human evolution by Charles Darwin. Extra-somatic intelligence today doesn't exist fully independently of extra-genetic brain intelligence. However, the theory of evolution of intelligence predicts that in the very near future nonhuman mechanical knowing will attain full autonomy and independence from human involvement.

Knowing acts (Epistemology of Practice): are the knowledge practices that are exercised to attain a specific objective of knowing. These include languaging techniques (e.g. argumentation, narration, and metaphor), social interaction techniques (e.g. imitation, meetings, and communities of practice), epistemological access techniques (e.g. reading, writing, and video watching), and praxis techniques (e.g. observation, reflection, and experience).

Knowledge as Practice: a philosophical argument that holds knowing a posteriori (empiricism) superior over knowing a priori (rationalism).

Knowledge exploitation: or simply 'exploitation' is an organisational learning theory that refers to the use of existing knowledge base to fully develop and utilise it for the application it was meant to address. Exploitation does not mean that external knowledge sources aren't absorbed. No matter the knowledge source, external or internal, it is primarily guided by existing knowledge, and is used to refine, develop, and evolve said existing knowledge. Examples include remodeling a production line to enhance efficiency and reduce meantime between failure (MTBF).

Knowledge exploration: or simply 'exploration' is an organisational learning theory that encourages rethinking away from established knowledge in previously unanticipated ways to grow the organisation into other industries. Knowledge exploration is an important topic in organisational learning because above all, it represents flexibility, which is a major premise for change. Examples of exploration include experimentation, exploring new possibilities, and challenging existing organisational processes and procedures.

Knowledge management processes: are defined dejure approaches to be implemented and managed for a specific objective of knowing. Knowledge processes include knowledge operations such as acquisition, codification, externalisation, assimilation, sharing, and application. Ideally, Knowledge management processes are often directed at managing knowledge itself (see Epistemology of Possession) in terms of access, presentation, storage, sharing, and searching. A knowledge process can engulf several overlapping knowing acts, for e.g. knowledge capture is a combination of exploration, sense-making, and know-what.

Knowledge Theories: knowledge theories are those questions contemplating the interaction of the mind with different knowledge sources; for example, focal and subsidiary awareness, epistemic relativism and intuition vs intellect. Knowledge theories tend to explore and examine subjective epistemological concepts such as truth, experience, and rationality.

Organisational Ontology of Projects: is a term designated to invoke project and project management as interpreted by influential management scholars who advocate the introduction of organisational management strategies into project environments. The organisational ontology challenges the notions of projects temporality and triple constraints by redefining projects as a 'temporary organisation' rather than the classical 'temporary endeavor'.

Processual paradigm of knowledge: is a philosophical understanding of knowledge that allows it to be in a continuous state of becoming. Ever changing and ever morphing, processual knowledge is independent of the knower epistemologically rather than ontologically. The processual epistemology of knowledge is highly complicated and has no immediate practical implications.

Social Theories of Knowledge: Social theories of knowledge are those ideas explaining the rise of knowledge as a product of social interaction; for example, the social construction of knowledge, language games, and symbolic interactionism. Social theories of knowledge tend to explore and examine intersubjective epistemological concepts in terms of languaging, reality construction, and social interaction.

Tacit dimension of knowledge: introduced by Ikujiro Nonaka in 1990, the tacit dimension of knowledge arguable initiated the professional and scholar field of knowledge management as it is known today. The concept was burrowed from chemist turned epistemologist Michael Polanyi who argued that all knowledge is personal and innate – tacit – and knowledge that seems to exist independent of the knower – explicit – is an illusion of tacit rooted knowing.

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Appendix: The Empirical Research Record

This document follows the research's data collection/ data analysis process. It is divided into three sections;

The first section details the general preparation, arrangement, and approaches adopted to conduct the empirical research. This is the first phase of empirical research. The second section follows the daily process of grounded theory coding and comparative analysis of collected data. It is divided into three stages: substantive coding, theoretical coding, and sorting drafted memos. This is the second phase of the empirical research. The third section follows the process of qualitative document analysis; a standalone research method implemented as means for triangulation. This is the third and final phase of the empirical research.

It must be noted that this document is not meant to describe, explain, or discuss the research topic; rather it is meant to provide a record of the execution and practices of the empirical research as it progresses through its theoretical build up. It must also be noted that this document does not contain the full empirical record process; the content presented here is a selected 19,000 words portion of the original 89,600 words and is just intended for demonstration. The complete empirical research record can be provided upon request.

The researcher has made sure to organise this document in a manner that is simple to navigate through and fully comprehensible to the reader.

Quick Statistics of the Full Empirical Research Record

Number of project phases recorded:
3 phases

Number of extended field notes:
410 field notes

Number of words of extended field notes:
50,049 words

Number of incidents recorded:
1970 incidents

Time period of grounded theory empirical research:
8/MAY/2016 to 18/OCT/2016 (5 months & 10 days)

Time period of document analysis for triangulation:
2/JAN/2017 to 21/FEB/2017 (1 month & 20 days)

Number of documents collected & analysed:
91 documents

Number of triangulated saturated core categories:
4 core categories

I. Preparations, Arrangements, & Approaches

Objective: *Setting the mentality, planning the practicalities, and scoping the empirical research goals and limits for data collection and data analysis*
Practice: *Carefully study and implement chosen research methodology*
Process: *Monitor and control empirical research progress on selected research scope*

The following is the script of an email sent to the researchers' Director of Studies and UoM advisor by the researcher. Sent on 13/10/2016, the email was an update on the progress of the research and it details the preparations and approaches taken at the offset of the empirical research:

Dear Prof. Ashly and Dr. Paul,

I would certainly like to share my collection/analysis cycle; the thing is, they are much jumbled and all over the place on different papers and digital files. But I can certainly take you through my process. What I have done is basically <u>field noting and document collection</u>. I was asked not to do any 'physical' recordings, like sound recording, or video camera, or take pictures. The name of the organization is also withheld.

The study is conducted on a 'digitization project'. The project is basically the implementation of a computerized maintenance system. The phases of the project recorded so far are the initiation phase, the selection phase, and the pre-implementation phase. This is a backyard study: I'm an employee at this organization and I'm directly involved with this project since I am the maintenance engineer.

I was worried that field notes couldn't be used as a data source in grounded theory, but it turns out that it could. I extensively depended on Emerson, Fretz and Shaw 2011. I've read the book like twice, and it is my 'to go' to reference when I'm confused. One of the best features about this book is that it doesn't just explain ethnographic field noting, it also explains the field noting process in general.

So in brief my field noting was:

1. *<u>Raw notes</u> on a research notebook (not a journal)*
2. *<u>Expanded notes</u> typed digitally sometimes, and long hand other times. Whatever is <u>immediately</u> available.*
3. *Raw notes <u>jottings</u> slowly in time extended to become big sentences and then full paragraphs. I've reached a point where my expanded notes are my raw notes.*
4. *I've recorded interviews, processes, meetings, and practices. I recorded in-vivo and in-vitro codes.*
5. *I'm doing <u>open jotting</u>. Meaning that everyone around me can see me all the time with my notepad taking notes. I think this removes tensions and dissolves any ethical dilemmas. Plus the noting has been plenty useful to the project.*

6. *Everyone is comfortable around me as a research since they are used to me as an employee who carries around notepads before this study began. The only ethical dilemma I face is the resistance to the digitization project. I have noted its details, but I don't think I would be able to publish it.*
7. *I alternate between 'researcher mode' and 'employee mode'where I think necessary. My researcher mode is very detached, objective, and descriptive; my 'employee mode' is somewhat analytical and involved.*
8. *I'm not worried about the writing style or spelling mistakes or consistency. I write all I can remember as fast as I can. Sometimes I get analytical while I'm noting. I would then make a choice: should I write the memo and risk losing the incident? Or should I write the incident and risk losing the memo?*
9. *I write in chronological order. I find it most helpful.*
10. *I write more in 'episodes' (events that describe process) than 'sketches' (events that describe a scene). For obvious reasons.*
11. *When I started field noting, I wrote in a very relaxed manner knowing that only I will be my reader. As I progressed, I started writing in a manner with the thought that I will have other readers.*
12. *Multiple voices and points of view: My most dominant point of view in field noting is the omniscient POV. I'm not studying the structure, culture, social behavior, or social environment. I'm objectively observing all acts of knowing that contributes to the project's progress.*
13. *My writing is mixed between 'real time' and 'end-point', that is; recording events as they occur, and recording events after they occur.*

These are just a rough idea about my data collection process. My data analysis is the regular "all is data" Glaserian grounded theory. I code the data, write memos, do literature review, and group items and compare them. I have done a 4 page simplified rough version of the saturated categories. Find it in the attachment. Please don't share it with anyone as this is pretty much what I have been working on for the past 3 years.

I think I need till the end of this year to completely finalize my data collection/analysis. I hope this email gave you an idea of where I'm at in my research.

Best regards,

Ghassan

Ethical Considerations

- Incidents related to organizational resistance are omitted to avoid any harm on participants that may be caused as a consequence.
- All businesses names, titles, and details that define the companies involved in the project are omitted. This was done upon the request of the CEO and the participants.
- Documents and emails involved in the study are not to be disclosed to protect the identity of the companies involved in the project.
- Pseudonyms used to protect the identity of the participants
- Cameras, voice recorders, and video recorders were not used during the empirical research upon request from the CEO.

Theoretical Sampling

The project itself was a knowledge management project (digitization of maintenance operations). Participants chosen for the research are those who are involved in the project directly or indirectly:

1. Maintenance department workforce
2. Operations department head
3. CEO – (initiated the project: project carried out on his request)
4. Project coordinator
5. Financial department head
6. Facility management service providers (companies)
7. Software providers
8. Work colleagues curious about the project or the research
9. Documents related to the Digitization Project

Participants Pseudonyms

To protect their identity, all institution and participants names will be given pseudonyms based on a generated alphabetical code.

I. Coding & Comparative Analysis

STAGE ONE: SUBSTANTIVE CODING Objective: *Discovering categories and core-categories* Practice: *open coding and selective coding (in that order)* Process: *All is data*

#	INCIDENT (I#)	OPEN CODE (OC#)	SELECTIVE CODE (SC#)

PROJECT PHASE I: DEFINITION & INITIATION

8/5/2016
Sharjah Office

(Before lunch break)
Field note: F1

1	My professional email address (a domain from Etisalat servers) has reached its full quota. No emails can be received or sent.	*Work email max capacity reached	
2	I did not want to delete old emails for space (they contain important records) so I called the IT administrator FZ. I also needed something else from him; I need him to give me access to the local public server, which we call the "sharing".	*Contains important emails *Calling IT for help *Need access to local public file sharing	
3	I plan to use it professionally and for my research. The "sharing" access I ask for holds a lot of files and folders on maintenance operations.	*access for professional and personal use *contains work data	
4	FZ said he will pass by me today. FZ's office is just one floor below mine.	*IT department and management office one floor apart	

Field note: F2

5	I left my office and went to HN's. HN is the project coordinator assigned by CEO Mr. MZ to digitize the operations department.	*going to projects office *project: digitize maintenance operations	
6	The organization (XAX) already has a platform – called Clerk - on which its financial and leasing operations are running. However, the	*management platform already existing	

	software is weak and can not cover all the business requirements needed.	*platform is weak and doesn't run all operations	
7	Mr. MZ is aware of that. His strategy was to start off digitizing operations smoothly by implementing a simple integrated platform before purchasing a massive complex fully integrated, real time ERP. MZ would often explain the project by saying: "I want to remove the human factor"	*long sight strategy *smooth change to digital *simple system to complex system *human factor – machine factor – information factor	
8	He calls it the "transition phase". His main aim was to get employees acquainted with working alongside digitally systemized procedures. This phase has been going on for almost a year now, and Mr. MZ thinks its time for the "Digitization project" to take full effect.	*transition phase *employees should get acquainted *transition phase takes one year *digitization project full effect	
9	And it is important that the project begins with maintenance operations, since leasing and financial operations are doing "OK" on the system, unlike maintenance operations which seem to cause a loss of time and money rather than aid.	* finance and leasing operations successful through transition phase *transition phase couldn't successfully cover maintenance operations	
10	This is where HN and I come into the picture. Since I am the maintenance engineer at organization XAX (I work at both Dubai and Sharjah branches), with management certifications, Mr. MZ has tasked me alongside HN to lead the project.	*project coordinator tasked to work with maintenance engineer to digitize maintenance	

Field note: F3

11	Mr. MZ has replied to HN's email with the project charter presented in slides as tasks in blocks. MZ calls the project charter "road map".	*road map (project charter) presented in powerpoint as visual blocks	
12	MZ has asked HN to separate the phases into different slides so that its more clear. HN has been working on it since Wednesday.	*blocks not very clear *divide blocks to phases and expand to other slides *took 3 days	
13	While going through it a final time before sending, she suggested that we might need a "data entry clerk." She draws up two more blocks and adds them as part of the project team.	*revising the last road map version before sending *idea pops up: data entry clerk *adds blocks into the slides for new idea	
14	We talk about it. I tell her its unnecessary given that our team needs to do the data	*Talking about it *team will learn the system better if they do the entry	

	entry themselves to learn how to use the system.		
15	She disagrees, she says that data entry clerks will be responsible for mitigating data from the old system and supervising data entry.	*disagree *data clerk: mitigation and supervising learners	
16	I tell her that that sounds like part of our tasks. She says true, but she doesn't know much about maintenance operations. I tell her she can learn.	*arguing: its our task *arguing: not possible; HN doesn't know enough about maintenance *arguing: she can learn	

Field note: F4

17	I go back to HN's office to discuss software vendors we have picked up online.	*going projects office *discussing software vendors	
18	Each have called them up and asked them to send us brochures or slides or print screens or catalogues or any documents that fit our business requirements.	*contacting all vendors *send us options and offers: slides, brochures, print screens, catalogues any document *fits business requirements	
19	The business requirements we have drafted were drawn from our SWOT analysis of the current software – Clerk .	*SWOT analysis of Clerk + discussion = business requirements	
20	And that is why we often refer to the business requirements as "opportunities/weaknesses" or simply "opportunities".	*therefore business requirements = opportunities/weakness or opportunities	
21	In HN's office we find it difficult to match and study the documents sent by our vendors using the computer, so we decided on a physical filing system. We printed out all the files and divided them into files.	*matching and studying of documents difficult by computer *physical filing system for easier study *printing and dividing and filing	
22	Meanwhile we were still getting some calls from vendors who said they will get back to us.	*still on phone with vendors for missing or extra documents	

Field note: F5

23	So far we file 6 vendors. We discuss our options before we closely study them. Should we go for a CMMS platform (maintenance focused)?	*6 vendors filed *so far (there will be more) *discussing system: focused maintenance?	

24	Or an expandable one such as FMS or ERP? Mr. AR has already told us that he prefers an FMS.	*discussing system: expandable full inclusive? *operations manager prefers full inclusive	
25	We talk about it.	*Talking about it	

Field note: F6

26	We started studying each file closely. We picked up [Software Provider 5].	*studying files closely *picking one specific file	
27	A first skim through makes me and HN suspicious. HN says in Arabic “mesh mertaha” literally meaning “I’m uncomfortable”.	*first skim through *HN is uncomfortable with it	
28	Because we are unsure about their support (after we purchase the software) mainly because they seem to have a small distribution office only.	*small distribution office *concludes: support could be weak	
29	We scribble all our thoughts down on the documents. We also note in red what is missing from our opportunities list.	*scribbling thoughts on documents *noting in red what is missing from opplist *red to draw attention	
30	It later becomes clear that the vendor tried to “tear and patch” different functions from other modules to create a maintenance module or to fatten it up. I told HN this may create a lot of integration problems.	*insight: tear and patch * tear and patch can create a module that isn’t available or fattens up modules *would create integration problems	
31	HN decides to call vendor and talk to them about it. Vendor’s phone always seems busy. HN again says “Im uncomfortable”.	*calling vendor to discuss this *vendor busy, HN goes uncomfortable	
32	I told her to use the land line. She calls them up and discusses this issue.	*use landline instead of mobile *vendor picks up. Discussing issue	

Field note: F7

33	We noted that all the vendors have different monikers of same modules and functions. Monikers also seem to differ when using the general term.	*same functions, different monikers (branding?) *general term, different monikers	
34	This has caused confusions and misunderstandings. Some vendors were aware of it, in fact one vendor – [Software Provider 4]solutions – mentioned this in the email along the attachments.	*caused confusions and misunderstandings *vendors aware of this problem *one vendor addressed it in email	

Incidents 35 to 570 are omitted from this document. The full empirical record can be provided upon requesting the concerned party.

PROJECT PHASE II: SELECTION & PLANNING

31/5/2016
Sharjah Office

F98

571	HN and I just finished the software (SOFTWARE AA) demonstration with Mr. KKV from[Software Provider 1]. The following are the details of the demo:	*1st software demonstration *software name *company name	

<u>572</u>	<u>Demo#1</u>		
573	-[Software Provider 1] has developed their own software ***[INFORMATION REDACTED TO PROCTED IDENTITY]***. It started off as an ERP for manufacturing, and then in time it expanded to include other areas, such as Real Estate and Facilities Management.	*company developed its own software *started as ERP for manufacturing *ERP software expanded to include other areas: real estate and FM	
574	- Mr. KKV took us briefly through the process of purchasing and implementing the software. There are five basic steps to it:	*going briefly through software purchase and implement *divided into 5 steps	
575	1. A team from[Software Provider 1] will first come and conduct a detailed study not just on our requirements but also on our capabilities. This is so that they ensure and guarantee the software they are offering will be fully customized to our processes and operations. Any mishap would make the team from [Software Provider 1] liable at this stage.	*conducting detailed study *requirements: what we need, capability: what is possible *software fully tailored to us. No such possibility? * liability on vendor in this stage	
576	2. After the study is done and approved, the package software is modified and customized to meet our identified requirements. During and after the installation phase, it is inevitable that new requirements come up or change. These extra customization would incur costs on XAX if it is decided that they be applied. However, there will be a warranty of 1 year on the approved customizations and modification that they will cover the expected requirements.	*study finalized and approved *software modified and customized according to study *inevitable: new requirements will come up/ need change *customize? Will extra cost *1 year warranty for all approved customizations	

577	3. Training of our staff and evaluation of the software will follow after the installation phase. This will be a 7 working days training and trial. If during this period XAX is not satisfied due to some reason or the other, XAX would retain the right to return the software and get fully refunded.	*7 days training and trial *7 days: if not satisfied, full refund	
578	4. This whole process would not take more than 30 working days.	*all 3 steps: 30 working days	
579	5. Future updates and future upgrades and further training will incur costs on XAX.	*extra customizations and training = extra cost	
580	- As I speak to KKV about the backend integration, we discuss our options of the phasing out period and the cut off period. KKV tells me that they would need to be in contact with the Clerk developer team to do the latching. This might take up to 6 months or more or less.	*speaking about backend integration *discussing phase out/ cut-off period *in contact with Clerk developers *latching- about 6 months	
581	- KKV makes clear that their software is not “off-the-rack”, it gets molded into our projected business requirements before installation.	*not off-the-rack *fully molded before installation	
582	- He believes in “minimal support from our end” giving the client powerful and dominant configuration options of the software (HN didn’t quite get that, she asked for this point to be repeated again. KKV explained it again saying that all customizations could be made as configurations. HN isn’t very convinced.	*give client full configuration ability = min support from vendor *repeat again didn’t understand *explaining again *easy configuration as easy customization *not convincing	
583	- Their implementation team would also act as consultants during the initial phase and advice us based on experience what modules and functions to take and what modules might be extra or unnecessary giving us cost effective solutions. This is so that interface for users would be faster and more efficient, and not unnecessarily complicated.	*implementation team= consultants *advice and counsel based on experience *important functions vs extra unnecessary functions **solution cost effective **important: faster more efficient not unnecessarily complicated.	
584	- The first option that pops up on the screen after the log in shows that the software can serve multiple companies under one group. This is ideal for us since XAX’s structure is just like that:	*first screen popup *several companies under one system *ideal to XAX group of companies *multiple windows for multiple companies	

	multiple companies under one big group. KKV also shows us how the user can open multiple windows for multiple companies.		
585	- Options and control tabs are designed graphically as workflows.	*graphically designed control	
586	- Software is branded SOFTWARE AA and is Microsoft SQL based.	*branded software *sql based	
587	- Trend analysis control is under the button titled ‘Business Intelligence’. It is linked with dashboards and is fully adjustable, meaning that we can determine the variables we want to analyze.	*trend analysis = business intelligence? *linked with dashboards *fully adjustable	
588	- Exportation of dashboards as illustrations is possible into pdf or doc. Exportation of dashboards as data is also possible into pdf or excel or doc.	*exporting graphical dashboards – pdf or doc. *exporting data dashboards – excel	
589	- Can be formatted to have in-system emails. Can also be formatted have in-system chat but that wouldn’t be recommended since it wouldn’t be kept in the records as official documents.	*format possible?: in-system emails *format possible?: chatting *chatting not recommended *chatting isn’t stored as official documents	
590	- Job management is formatted as a calendar flow. Job details and process flow can be accessed once you click on a calendar block. (These are color coded).	*job management as a calendar flow *details, processes and other info upon clicking on date block *color coded for data	
591	- Has shortcuts: you don’t have to go through all the options to get to the function you need, you could put it as a shortcut button.	*shortcuts: faster easier access	
592	- For reports generation it has reports library and “create a report” button.	*report generation: library *report generation: create	
593	- Input: can take direct input from excel sheet files are well	*importing from xlc	
594	- No need for duplications: can generate and edit excel worksheets.	*export to xlc *can edit sheets within system	
595	- Under different functions, it has different search engines.	*different searching for different functions	
596	- For immediate input, drop down can also be provided into mobile app and the computer system.	*drop-down can be provided *desktop and mobile app	
597	- “we have everything you need, but we’ll have to package it for you” as we go through the software demonstration, I	*everything available. Choose to integrate and package *perfect example: tear and patch	

	could see that this is a perfect example of a ‘tear-and-patch’ platform.		
598	There are so many functions and so many modules from all over different businesses. They don’t really have a specific maintenance module or a solid defined ERP either, it’s like a little bit of everything. Once the client defined his requirements, then the software gets solidified into something specific.	*many functions. Many modules. Different business. *no defined solid module *a collection of everything *after requirements: software gets assimilated and packaged	
599	This makes me uncomfortable because it might be incomplete or might have some integration problems. This also makes me think about future support and whether they will be able to give.	*integration problem? Incomplete somehow? *future support? Remember: they believe in min support	
600	Mixing and matching all these different functions and modules can also create a maze for the user: it makes it hard to go through. Perhaps that’s why they have the short-cuts option? I wanted him to elaborate more on this issue but I held back. I make a mental note to go through it again in the future.	*mixing + matching = maze *difficult to navigate *that’s why shortcuts? *don’t elaborate. *Making mental note *will question it again	
601	-System documents, pictures, files etc. saving go to a different database inside the server. The program will just act as the interface or communication between the user and the data. This is important because if the system itself acted as the database, then it would have limited data upload and would lag when the storage is full.	*data saved on separate server *software working on a separate server *software= interface/communication with data *as much storage space as we have servers *will not lag	
602	- Maintenance button under leasing has a description text box. It is for detailing the progress of the job.	*description text box *detailing progress, capturing progress?	
603	- There is also a monitoring option that confirm any user who viewed a maintenance job (it’s like a message-read receipt)	*job read receipt *enhancing communication	
604	-[Software Provider 1] can also provide barcode reading and barcode generation for our assets (asset tagging).	*asset barcoding and tagging services	
605	- KKV showed us a customization control: system architectural mapping of functions and modules. This was	*customization control *full system map *presenting: fluidity and simplicity of customizations ability	

	supposed to show us that the fluidity of the customization is under control,		
606	but HN and I think it is way too fluid to be fully controlled. There might come a time when the source code bugs in the future. That would create a serious issue. To me it seems that a lot of functions and modules are not in control.	*too fluid = out of control *source code bug? Will propagate *bug will be hard to find	
607	- KKV then tells us that from his experience, the initial stage of defining business requirements and capabilities should be dialed down to the minimum functions and modules: those that are most important and essential	*experience: concentrate on the basic necessary requirements first *most essential functions to our opplist	
608	. Involving other modules that may look amusing to use but are extra ("wish list") in the initial stage is a mistake. The "wish list" modules can be installed later after the basic requirements are fully covered.	*wish list modules = extra and might be useful *don't concentrate on it in the initial stage *first fully cover functions for opplist Then other wish list functions	
609	- KKV tells us that as part of their customer support program, we will have a monthly check up during the first year. Someone from [Software Provider 1] would visit us and help out, take in inquires, clarify unclear issues, give advice, follows up and makes sure that every user is happy.	*first year: monthly checkup support *clarify, advice, follows up, all is happy?	

2/6/2016
Sharjah Office

F99

610	HN and I just finished the software demonstration with Mr. WKS and Mrs. MDA from[Software Provider 11]WARE. The following are the details of the demo:	*demo finished *details recorded	
<u>611</u>	<u>Demo#2</u>		
612	The software they are demonstrating is their CAFM platform. *[Information redacted to protect company identity]*	*CAFM platform	
613	The software is oracle based. They tell us that CAFM has more functionalities than CMMS (CMMS is a part of a CAFM).	*oracle based *CAFM more functionalities than CMMS *CMMS part of CAFM?	

614	HN and I have our doubts about this. Our research tells us that a CMMS can also be bigger then a CAFM depending on many things. However, HN and I refrain from commenting and gave them a chance to explain themselves.	*doubts *CMMS can be bigger than CAFM *size of platform depends on many things *refraining from commenting. *benefit of the doubt	
615	Their product is an "off-the-shelf" package with core modules and optional extra modules. There will be no customization pre-installation. Any customization will cost extra. The system's modules and functions is very well defined and not expandable. However, it is scaleable and can be integrated with other softwares.	*off-the-shelf product *core modules and (optional) extra modules *no pre-install customization *all customizations will incur cost *well defined solidified modules and functions *is not expandable to another system *scalable (can grow more functions) *can integrate with other systems	
616	They tell us that as a robust ability, the system is not designed user-wise, rather as building-wise (not per user, per building).	*robust ability: system control structure not user-wise; instead building-wise	
617	We were worried that since Clerk is SQL based and their CAFM is Oracle based backend integration would not be possible. However, WKS and MDA assure us that SQL and Oracle have "open windows where they can shake hands" for integration.	* Sql and oracle, backend integration problem? *assuring: open windows where they can shake hands (sql and oracle)	
618	This is actually important for all software vendors. They understand that a lot of businesses want integration of backward compatibility with their existing software. It is called "domain expertise" and it ranges all platforms from "those used by doctors to lawyers to facility management service providers".	*explaining: integration is very important to all software vendors *companies almost always have several management softwares * software integration skills: domain expertise *can interlink all management platforms of all kinds	
619	The CAFM they are offering comes with a predefined coding for interface with BMS sensors. This is advantageous for us if in the future we decide to transform our management into a BMS based one. We wouldn't have to put in any extra cost, or make major system changes.	*system has predefined codes for BMS sensors *advantage: transform management software into a full BMS *no major costs required *no major systems changes required	
620	There are many modules and you buy the ones that you want to use: license is	*many modules *buy any to use	

	per user. They have standard core modules (must buy) and standard specialized modules.	*license per user *core modules (must) and specialized modules (optional)	
621	As they were developing the software, in time some specialized modules became core modules and vice-versa: for example energy management became a core module.	*as software developed: specialized modules became core modules. *also core modules became specialized modules *example: energy management	
622	They will study our business requirements with us before they recommend which modules to use (consultation services)	*consultation services *will study business requirements with us *will not take business requirements just by our studies	
623	System has contracts/suppliers profiling and evaluation so we can determine things like: are the technicians working on schedule? Are they taking a long time solving a problem? Are they working on schedule? Should I continue my contract with them?	*contracts/suppliers profiling *for evaluation and analysis *examples given	
624	All data of all formats is saved in a separate database and not as part of the system. The system acts as a communication or an interface between the user and the database.	*data of all formats can be saved *separate software/data databases *software is the communication/interface between user and data	
625	Software is web-enabled: can be accessed through a web domain and sub-domain in Abu Dhabi or Dubai, or Sharjah, or New York. User then would just have to log in his credentials.	*access option: web-enabled (www) *given web domain and sub-domain\ *log in credentials	
626	Access to software can also be as LAN (if we want to restrict it to our servers).	*access option: LAN *security purposes	
627	The basic job management process in the system flows something like this: helpdesk takes the call, enters the claims on the system, claims get routed to the maintenance supervisor who then assigns the technicians or engineers, the technicians then receive a ping on their mobile app with the maintenance job details. The technician then accepts the job with ‘open’. Then as he is working he updates with ‘in-process’ or ‘starting’ or ‘finished’ or ‘closed’ with job details and progress and pictures.	*job management process in system *taking call *entering claims *claims routed to specific personnel *assigning work to individuals *mobile-app pining assigned individuals *accepting: ‘open’ *updating: ‘in-process’ or ‘starting’ or ‘finished’ or ‘closed’ *data entry from site: pictures, text etc.	

628	WKS and MDA noted that helpdesk doesn't have to be the only ones taking claims. Claim requests can be lodged by the tenants themselves through their unique ID and password into the system through the web.	*different ways to take claims *helpdesk, tenants, technicians etc. *using ID and password	
629	They can also have the application installed on their mobile phones. Once the claim is lodged, a confirmation receipt with the job number and assigned personnel and even timing is return to them.	*tenants: mobile app on their phone *after claim, confirmation receipt *confirmation receipt: job no, assigned, timing, etc.	
630	Claim requests don't have to be technical: the tenant can just type 'AC not working' or 'sink is leaking'.	*claim requests not technical *simple wordings to describe problem *examples given	
631	Centralized help desk can be segregated based on location with each helpdesk officer having access to the maintenance team of the building he is in charge of.	*centralized desk can be segregated *segregation: location-wise *segregation: team-wise	
632	Maintenance supervisor can anytime during the job request the job progress details from the assigned technician to follow up on the issue.	*maintenance supervisor options *requesting job progress details *request follow up	
633	Main maintenance window is made MEP direct and simple: big buttons with AC, Plumbing, Electrical, Cleaning, and Outside.	*system main window: MEP direct and simple *big buttons *divided by maintenance types	
634	These buttons are customizable. Once you click on one of them you get the jobs list with color codes and attachments (pictures or vedio).	*big buttons are customizable (rename function, change function, size, color) *clicking *job list color coded *attachments by side (pic or video)	
635	There is always a 'How to Use' help window on the top right side of the screen. If you click to expand it, it will show you the process in guided steps.	*help window (how to use) *click to expand *will guide process	
636	The software's general look is very user friendly: easy to use and window blocks (all options and selection buttons)	*general look: user friendly *easy to use *window blocks (as buttons)	
637	A super-user access would have the options to all buildings on a geographical map. He can click on any (drop pins) country in the map to access those buildings.	*super-user access: all data divided building-wise *presentation: as geographical map *click - drop pins *will access each building	

638	The software is object-oriented: now what this means is that everything defined in the source code is object based. This means that any customization to be made need to be object identified and in hierarchy, for example location, buildings, assets, items, calendar etc.	*object-oriented software: source code is defined as object based * objects to be identified *object identified in hierarchy *examples given	
639	This would increase the scalability and agility of the software. This is also important to us because what this tells us that even if there are no sub-categories and technical specifications, attributes, or sets defined inside the system, it can be easily programmed with no integration problems.	*object oriented software: scalability and agility bigger better *also: built for categories and sub and sub sub. Specifications defined directly *no integration problems	
640	The system has its own default library of assets.	*default asset library	
641	Technicians and engineers portfolio options: picture, certificates, visa, work expertise, responsibilities, current work location.	*personnel portfolio *very comprehensive *touches on HRM	
642	The core system allows only ten dash boards views, but the dashboards are fully adjustable, meaning that we can determine the variables we want to analyze.	*core: 10 dashboard views at a time *each dashboard fully adjustable *any variables can be used	
643	Trend analysis or dash-boards are interactive: you can hover the mouse over figure to display more information, or you can click on a monthly bar to enter another chart which is weekly, and click on a week bar to enter a chart which is daily and so on.	*trend analysis, dashboards are interactive *hover mouse to display data *click on one bar in a bar chart *will give a separate barchart for one bar *can be nested all the way *example: yearly, monthly, daily	

Incidents 645 to 1492 are omitted from this document. The full empirical record can be provided upon requesting the concerned party.

F274

1493	HN asks me if I know someone who might help me classify the items, and I tell her AR and AS, but they are busy.	*implying: someone might help me classify the items *there are, but busy	*implying *cooperation with team
1494	I think maybe we will just list the items the way they are classified and create the tech specs with the help of the software company we choose to work with.	*thinking loud: list items as classified – create tech specs with help of software providers *providers will have experience with this	*thinking loud *cooperation with vendors
1495	After all, they will have to design their tech specs the way that best suits our operations. HN tells me that we will discuss this later.	*it will be one of their tasks anyway *will discuss this later	*discussion matter

15/8/2016
Sharjah Office

F275

1496	I think I have collected enough items to start organizing them into categories and create their tech specs. I discuss this further with HN and she agrees.	*thinking: enough items to categorize and create tech specs *discussing with HN *HN agree	*enough knowledge for structuring *taking opinion (discussion) *agree
1497	I would still have to go and register more items from outside the store. These will be the assets, the ones being used.	*considering other task of asset registration *considering how it will add to the tech specs	*considering other knowledge source for other purposes *considering mashing different knowledge purposes in one knowledge structure
1498	For now I would sit at my desktop and try creating categories and subcategories and tech specs. Basically I want to create structure to link loose data.	*plan: sit and create categories and sub categories *use this data to create tech specs *create structure to link loose data by finding the common parameters between them *these parameters will be the product that I need	*planning step by step how to create knowledge structure

F276

1499	As I was going through the rough notes and the word files I've typed them out on I noticed some inconsistencies:	*comparing: going through typed word file and rough physical notes *noticing inconstancies	*comparing various knowledge representations *noting inconstancies
1500	there are some items which I have registered more than once, and some of those have conflicting data! Two of them to be specific: a Hitachi fluorescent lamp and a metal halide lamp.	*same item registered twice *same item with conflicting data *being specific	*small mistakes

F277

1501	I went back to the store and obtained the correct data, and made a quick scan around randomly on items just to make sure everything's ok.	*going back to store *obtaining correct data (revising physically) *randomly verifying data of some items	*revising knowledge from physical source *randomly
1502	I then go back to my desk and resume categorizing and organizing. As I do so, I open up the 'maintenance items' list with the tech specs that I have done de Jure.	*back to desk *resume categorization and organization *for support: opening de Jure list	*structuring knowledge *using de jure list as a knowledge source

F278

1503	I note that there are quite a lot of similarities in the de Jure tech specs sheet with the items I have recorded. I think I can fit the data into it, but it wouldn't be complete.	*noting similarities: de jure list vs. recorded list *can fit recorded items in de jure list but wont be complete *implying: data can be fit into each other	*let de jure list define base knowledge structure
1504	I thought that I would use the de Jure table anyway and expand, change, and re-organize it instead of starting everything from scratch.	*idea: use de jure list itself *expand, change, re-organize *don't start from scratch	*let recorded data expand, change, re-organize base structure *use knowledge source to start building on

F279

1505	SHD passes by to use the photocopier machine and we start chatting. He asked me what am I doing and I tell him.	*SHD passes by for photocopy *chatting *asks what aim doing	*chatting

1506	He starts then playing with the idea that there should be some kind of a program that fuses the de Jure list with the real items list automatically.	*playing with an idea *a program that fuses de jure list with real items automatically	*playing on idea *auto fuse = auto knowledge structuration
1507	We talk about it and decide that in order to do so, hypothetically it should be able to expand, delete, add, verify, and most importantly, identify and match.	*hypothetically talking about it *discussing what its function should be *most importantly: identify and match	*hypothetical *discussion
1508	SHD jokingly tells me that this way I would be out of a job! I tell him on the contrary, it will make my job faster, easier and more efficient!	*joking: program will replace me *rather; it will make my job easier	*joking
1509	All I have to do to prepare the finalized tech specs is upload the items, and the de jure list, and click 'merge'! It would take fraction of a second and I would immediately send it out to the project team!	*continuing to think hypothetically *wishful thinking: prepare docs, upload items, upload de jure and simply click merge *fraction of a second *will immediately generate result	*taking hypothetical seriously *wishful thinking

F280

1510	I just noted another inconstancy. I registered a safety transformer with 12V 50W 4.2A, but I hadn't registered its step up or step down parameters.	*noting another inconsistency *item data missing *cant determine item type (step up or step down)	*noting mistake *data not available
1511	I went back to the item in the store and saw it is a 240-12 V, 0.23- 4.2A safety step down transformer.	*back to store *data found *step down	*data source from physical location

16/8/2016
Sharjah Office

F281

1512	While I was keying in data for R.C.D.s and interrupters, I remembered that there were a lot of tech specs that I couldn't understand while registering.	*while keying in data *remembering: tech specs I couldn't understand	*while – reflection *remembering

1513	When I went online to check them, it looked like a needed a 4 months course to understand them!	*going online to search for them *very complicated very big	*knowledge source: online
1514	So I went to AR and I asked him about it. He took a look at it and smiled and told me that these things are specified in the plans and drawings by government and manufacturing standards.	*going to AR for help *AR smiles (he knows this) *some specs are only available as government and manufacturing standards	* help (cooperation)
1515	We don't fully understand them; we just get them de Jure as per the standard government requirement for a system (they appear in the architectural autocad plans).	*don't fully understand them *aren't required to *they also appear in architectural drawings *from government or consultants	*no need to know
1516	I told him I looked them up online, and he told me that I wouldn't find them online. These are manufacturer secrets and intellectual property.	*looking online, not clear, very hard *wouldn't find them anyway *manufacture secrets and intellectual property	*can't find them * intellectual property

F282

1517	Going through the fire alarm system components that we have and I realized that all the company names I have listed aren't the manufacturers' of the devices (sensors, sounders, switching modules, and programming boards).	*going through registered fire alarm components *realization: listed names are not the manufacturers', rather distributors	*going through *realization = reflection
1518	I went to AR again and he told me that it's true. He tried to remember the name of the manufacturer and then goes to google searching.	*going to AR again for help *AR confirms *cant remember the name *google search	*help again *confirm *search data
1519	He finds it: WORMALD. He told me to list all the fire alarm items under WORMALD, instead of putting them under the distribution companies.	*finds name *list under manufacturer, not distributors	*finds data

F283

1520	I made a photocopy of the physical papers that contain all the items I have registered long	*photocopying physical papers with long hand registered items	*photocopying physical papers

	hand and gave the photocopies to HN.		
1521	HN tells me there's a lot that is not clear, and I tell her its ok, this is a rough copy that I'm keeping with her incase I lose mine.	*theres a lot *not clear *its ok: its just a backup	*not clear, unintelligible
1522	She might also want to take a quick look through at the registered items, or keep it for future reference (she may need it I think to myself).	*also *a quick look might help her *she can keep it for potential future reference	*quick look *potential reference
1523	But she insisted that I clarify some things so I did. She used highlighters and different coloured pens and her notebook to note down a concept I explained to her (about safety ratings IP).	*insisting I clarify some things *using highlighters and colored pens *using her notepad *writing what Im explaining	*clarify *transcriptions to explain *transcriptions to understand
1524	There was even a mix up with a page number and a specs number at the top of the page that I had to explain/clarify!	*mix-up: page number and item number *due to rough noting	*rough noting unintelligible
1525	Other mix-ups/confusions is when there is the same item but with different current ratings so I would just draw n arrow pointing to a new rating instead of re-writing the whole item specs again.	*other mix-ups *same item different reading are indicated with arrows *instead of re-writing	*explaining inscriptions
1526	I guess my writing is too rough and only intelligible to me.	*my work *too rough *intelligible only to me	* intelligible only to me

22/8/2016
Sharjah Office

F284

1527	As I create classifications and categories for the items. I realized there are a lot that I can include and a lot I can ignore to find consistency between all items.	*as I create *I realized *can include and can ignore to build consistency with all items	*act of reflection *idea *act of patterning
1528	It's like finding the 'mean' from all the items (I wonder	*metaphor: the 'mean'	*building calculator

	if I can work the same way and find the ‘standard deviation’ of the items).	*taking metaphor a step further: ‘standard deviation’	*hypothetical calculator
1529	So when there are missing specs, I go online and I look them up and try to fill the gaps. Problem is when I can’t find the gaps to fill, so I have to reclassify again in hopes of finding the common specs available and avoidable.	*trying to find common specs between all items *if specs missing: look them up online *if extra specs, cancel them *filling gaps *if filling gaps not possible, reshuffle, reclassify	*organizing *common ground *shuffling

F285

1530	When I classify and reclassify I find out some errors in the items registration that I hadn’t noticed before. For e.g. I have noted down: “Extractor fan size 23mm/9in”. It’s actually 230mm.	*classify and reclassify: errors detected *example given	*repetition *detection *example
1531	Another example is the IP rating of the extractor fan. I had written “X7” but it is X4 rating.	*another example	*repetition *example
1532	This is actually a handwriting error (handwriting not clear) that I had typed wrong on the computer.	*error types: handwriting, typo, data missed, data misinterpreted	*error types

F286

1533	I’m telling myself that perhaps its better that we don’t create son many category levels.	*thinking as I work (telling myself) *better to reduce category levels as much as possible	*thinking *reflection *idea
1534	So instead of category-subcategory-subcategory (with specs), its perhaps better if we divide it all as categories-subcategory (with specs).	*two levels specs is better than three level specs	*decision
1535	So for e.g. instead of electrical-switches-electric switches specs, it will just be switches-switches specs.	*example	*example

1536	There is no need for the overall 'electrical' or 'plumbing' to take the highest level of the items, their names are obvious to what they are and what group they belong.	*to make this possible: don't remove lower levels, better remove higher levels *canceling high levels names *group name obvious or not needed (?)	*architecture *designing
1537	For sure under job order that would be different. The overall category name is needed before there is a sub-category defined under it. I don't think we can cut down the levels there.	*comparing: job order levels, and item classification levels *higher level identity for job order needs to be there	*compare *designing
1538	Maybe we could? I'll talk about this with HN.	*which levels can be omitted? *will talk	*architecture
1539	Meanwhile I will classify the items as first order categories without their overall 'what they are'.	*meanwhile item first level identity cancelled	*decision

F287

1540	As I fill the missing gaps of the items (using google more than going back to the store), I find out that a bell push switch of 3 poles can also be used as 2 poles.	*filling spec gaps *using google more than physical item as data source *learning something new about an item	*different knowledge sources *different knowledge sinks
1541	Now that I think about it, there is a lot of unexpected knowledge that just pops up like that. It's the kind of knowledge that isn't exactly useful. Or is it?	*considering overall *a lot of knowledge was gained this way *would this knowledge be useful?	*reflection

F288

1542	Sometimes the data I'm looking for is not available as a webpage; rather it's a downloadable pdf file (mostly datasheets).	*information can be on webpage itself *or download pdf	*knowledge presentation
1543	I would have to go through the whole 10-30 pages to find what I'm looking for; it's kind of a headache.	*pdf are headache *they are big *have to search for what I want within them	*knowledge interaction
1544	I wish it's just written factually under some table on the	*wishing its written clearly on web page	*knowledge interaction

	webpage. I don't want to click and download and read and search.	*don't want to manually read and search *easy fast access to information	easier, faster *knowledge co-interaction

23/8/2016
Sharjah Office

F289

1545	HN takes a look at my rough work so far (the categorization) and I explain to her what I have done.	*looking at rough work *explaining while looking	*inscription *explanation *knowledge source
1546	I tell her that in many instances I resolved to filling information in the cells under specs that isn't exactly what the specs column is asking for. For e.g., in lighting I would put under 'Item Name' a 'Ballast (50Hz)'.	*explaining a categorization method *idea to fill cells with other information than parameter application *example	*act using knowledge source *example
1547	This is because I don't have a 'Frequency Rating' column under 'Lighting Specs'. This is because not all lighting-related items come with frequency ratings.	*saves space *better structure *access to information compromised?	*weigh options *in thought

F290

1548	The other missing info/details/blanks on excel can be found online (hopefully) later.	*keeping cells blank *assuming data can be found later *from online	*decisions
1549	I thought it will be faster if I put down whatever I have now and then later I will extract the missing data to complete the sheets.	*reasoning: fill what is available now *extract missing data later *sheet has fixed structure/'rules'	*reasoning *rules for calculator

F291

1550	In some cells I would add data that doesn't exactly belong there. For e.g. under 'Color Temperature/Lumens', I would put the color itself when the temp or lumens is not available.	*adding related but not precise data *comply with rule structure *example	*bending data for rules

1551	Maybe I need a broader term than 'Color Temperature/Lumens' defining the column.	*wondering: broaden heading = can take different data *changing structure rules/ structure calculator	*bending rules for data

F292

1552	Sometimes I would merge two tech specs cells together if they have little data to fill in their columns, for e.g. under 'Sockets and Switches' I merged the two tech specs columns 'Fitting' and 'IP' into 'Fitting / IP.	*other solutions to categorize *merging 2 parameters *condition of merging apply *example	*making calculator rules and data meet halfway
1553	Either do that or look online in hopes of finding the data needed to keep the two tech specs columns apart.	*another solution *looking online *keeping parameters apart	*searching for other solutions *different knowledge source

F293

1554	I'm trying to put as much info (tech specs) about items as possible because I think it will be very useful in the future. That's why I hesitate a lot before deciding to delete a tech specs column. But I'm also trying to make the sheet look neat and not confusing.	*creating structure to fit all parameters *as much parameters as possible *more data, more analysis *hesitating, considering parameters carefully *compromise= more data vs. robust structure	* making calculator rules and data meet halfway *robust calculator vs more data
1555	So first thought about re-arranging the items alphabetically but then I thought perhaps it's better if I arrange them in categories.	*structure: rearranging data alphabetically *thinking: better if arranged as categories	*data rearrangement *for better structure *again
1556	HN agrees, but tells me not to be careful by ordering not to create a new category level. So for e.g. under 'lighting', if I group 'ballasts' alone, and 'metal-hallide lamps' alone, and 'fluorescent lamps' alone, I would be unconsciously creating a third or fourth categorization level.	*agreeing with method *warning: unconsciously create more levels *example	*agreements *caution *example

F294

1557	HN asks me to send her a copy of what I have done so finish up before the end of the week.	*send a copy *so far done *before week ends	*cascading *cycling

F295

1558	While I'm happy with the data and confident moving forward successfully with HVAC, Transformers, and R.C.C.B.,	*satisfied with structure rules *confident to move forward *successfully	*calculator created halfway
1559	I'm not so sure about Plumbing and Carpentry. I think I will have I hard time with structuring these items.	*not sure about plumbing *not my area of knowledge *will have hard time structuring	*two or more calculators *trying to assimilate calculators

F296

1560	HN tells me that she has updated Mr. MZ (who came from vacation) with the progress.	*MZ updated on progress by HN	*update
1561	He told her that for the 2nd demo sessions, it's not important that he is present and attending (something that HN disputes), but it's important that the "engineers" are present and attending.	*2nd demo session *not important he attend *important that "engineers" attend *HN disputes	*discussion *dispute
1562	MZ tells HN specifically he means Ghassan (me), HL (leasing and maintenance Dubai office), and AR.	*specifically: me, HL, and AR	*judgement

F297

1563	HN was confused at this but nevertheless told me that she will prepare an email and inform HL and AR about this by the end of this week.	*confused *nevertheless will act *email to HL and AR	*confusion *sense-making
1564	And so its better if I'm ready with the sheets. I tell her I will do my best.	*advice: finish the sheets *will do my best	*advice

F298

1565	HN tells me that she fears Mr. MZ's absence could prolong the project.	*concerned, worried *MZ 2nd demo absence = project delay	*expressing concern
1566	I tell her not to worry so long as we are moving forward but in reality, I myself am worried.	*reassuring all is on track *I myself am worried	*opinion *sense-making

Incidents 1567 to 1657 are omitted from this document. The full empirical record can be provided upon requesting the concerned party.

STAGE TWO:
THEORETICAL CODING
Objective: *Fully saturating Core-categories*
Practice: *Enriching, Delimiting, & Reduction*
Process: *Focus on category and core-category incidents*

#	INCIDENT (I#)	SELECTIVE CODING (SC#)	CATEGORY(IES)

4/9/2016
Sharjah Office

F324

1658	HN and I are preparing for the 2nd demo session with [Software Provider 13/ SOFTWARE II].	*preparing *2nd demo	Inscription Redundancy
1659	We go through the previous demo session notes from my research recording.	*going through *again	Inscription

F325

1660	Supplier base was not presented in the 1st demo session, but it was promised to be there in the 2nd demo session (supplier base not in the system, or not in the presentation? We will see).	*not presented, promise *we will see	Discussion
1661	So is purchasing which is not part of the system, but can be added.	*parts of system	Discussion

F326

1662	HN calls for a confirmation from HSS.		

F327

1663	HN and I then discuss the Master list (library items list). I took out my notes from the 2nd demo with [Software Provider 8] for this discussion.	*discuss master library *using notes	Discussion Inscription

1664	HN then tells me to bring those along into the 2nd[Software Provider 13/ SOFTWARE II]demo and compare them with what is being presented.	*bring along *compare/ use as reference	Inscription
1665	We also note that we need to ask about the CAD viewer if it can be embedded into the system or just an upload file.	*note	Discussion

F328

1666	After some research we note that a master library could be available for anything else: e.g. library for job flow library for items library for dash boards library for purchasing etc.	*research *note *example	Discussion Inscription

F329

1667	[Software Provider 13/ SOFTWARE II] 2nd Demo Session Remarks:	*remarks *2nd demo	Inscription Redundancy Discussion
1668	MZ: Put data somewhere, hit it with live. How next do I make profit?	*put data *hit data/make live	Technological Extension
1669	HSS: compare and analyze items, reports, contracts, jobs. Take decisions based on them	*compare/use as reference *documents *decision making	Extension Inscription
1670	Ease of use of mobile app: simple, relevant, and fast for technicians or those who aren't learned	*third promise	Technological Extension
1671	From the accounts point of view: a clear breakdown of item cost or any type of cost is made possible in the system	*first promise	Technological Extension
1672	From the administrator point of view: dashboards and KPIs clear, interactive and live	*first promise	Technological Extension
1673	Every specific person or department would have their own relevant information on their display screens (depending on the log in	*second promise	Technological Extension

	credentials and clearance levels)		
1674	MZ asks: is location tracker of personnel while on site possible? (for routine checks or job orders?) HSS replies after discussing with his colleague: can be made possible.	*third promise *reply after discussion: possible	Technological Extension Discussion
1675	Complaints can be lodged through by tenants or by the office. Some jobs are routine, some jobs are direct. This should all run smoothly and in sync. Workflow is made "cohesive".	*third promise	Technological Extension
1676	MZ: "show me, keep showing me" don't just say it "I like to see it"	*show me (presentation)	Inscription
1677	"Maintenance attribute" each asset can have its own maintenance option or job flow. For example every 2 weeks coils have to be changed. Basically the type, details, and steps of inspection or correction for every asset can be defined.	*first promise *example	Technological Extension Discussion
1678	They don't have embedded pdf or CAD viewers. The system can just upload the files. For these, we would have to have our adobe reader and AutoCAD.	*third promise	Technological Extension
1679	They have no globally standardized master library for items but can integrate us to O and M items US/UK based standards. This library automatically updates what's new, changed, discontinued, alternatives etc.	*first promise *idea	Technological Extension Discussion

F330

1680	After the 2nd demo session HSS and I had a little chat about the O (operations) and M (maintenance) items standards.	*little chat	Discussion

Incidents 1681 to 1766 are omitted from this document. The full empirical record can be provided upon requesting the concerned party.

PROJECT PHASE III: PRE-IMPLEMENTATION

4/10/2016
Sharjah Office

F354

1767	Yesterday HN and I sat together and discussed deeply the maintenance operations in a flat for handing over, during rent, and vacating.	*discuss deeply *topic discussed earlier	Discussion Redundancy
1768	We came up with a couple of things we had missed:	*what we missed	Discussion
1769	one is the structure or the format of the checklists of each form (mainly handing over and vacating), and two: the direct purchase.	*point by point verbally *format/structure *flow	Inscription Technological Extension
1770	Direct purchase happens when there is no need for LPOs.	*flow process	Technological Extension
1771	For example if light bulbs or a switch or a door handle is needed and isn't available in store, the team would inform AS who would buy it from a shop close around the area and keep the receipt for reimbursement.	*example	Discussion
1772	'Direct Purchase' was added to the work job flow chart next to 'LPO' under the purchasing routine.	*flow process positioning	Technological Extension

F355

1773	Today I go into more details with this. AR had asked me to come to his office. He is telling me that he had prepared a new (proposed) maintenance checklist for vacating an apartment.	*more details *telling me *prepare *form	Discussion Inscription Technological Extension
1774	He tells me to get the old one and the proposed one and go work with the team to test them and see if they are practically	*old and new forms *practically *test	Technological Extension Redundancy

	viable or if they are missing something or if they should be formatted differently.		
1775	AR advices me: the more apartments I check, the better the observations and recommendations I will make.	*more apartments= better focus	Redundancy
1776	He also suggests that I stay with the maintenance team instead of working on the checklist alone because I would also make note of their concerns, their ideas, and if they can use the checklist properly or changes need to be made.	*one job with many *stay with team *share concerns ideas	Redundancy Discussion
1777	While I'm using the checklist, I will also be taking notes. I figured inscription would be a good idea to proceed with it.	*test checklist + take notes	Inscription
1778 a	AR tells me he will also send the softcopy and when I'm done with the hard copy, I will fill up the excel sheet on my computer and make the necessary changes.	*softcopy/hard copy *excel sheet *changes	Inscription Technological Extension
1778 b	Later on we will sit and discuss these changes.	*discuss	Discussion

F356

1779	I forwarded the email with the proposed checklist attachment to HN and told her about it.	*forward proposed	Inscription
1780	She said she will also put in some comments and suggestions and use the final version to send it to (Software Provider 7/ Software FF).	*comments and suggestions *final version	Discussion Inscription

F357

1781	I just came back from reviewing the checklist.	* reviewing checklist	Redundancy

1782	I went with the maintenance team through 3 apartments, each time we go through one we note something we didn't notice before: for example the door's magic eye, the mirrors, and the door closing mechanism (not the lock mechanism).	*3 apartments *one job by many *noting	Inscription Redundancy
1783	The team tells me that when things like these aren't on the list they write them down themselves.	*write down missing items on formal list	Inscription
1784	Later after we took notes, we sat and discussed how the mobile application would best look like:	*using notes *discussion	Inscription Discussion
1785	Create it in a way so that most of their entry is either a tick or a check or a drop down list. This is so that writing is minimized.	*mobile app use way	Technological Extension
1786	Add the missing apartment assets to the proposed list.	*add missing assets	Technological Extension
1787	Adjust the description cells so that they fit better with the items they indicate	*adjust to indicate	Technological Extension
1788	List shouldn't be location-wise (bedroom, bathroom, living room etc.), it should be item-wise (A.C., wash basins, doors, tiles etc.)	*location-wise vs. item-wise	Technological Extension

9/10/2016
Sharjah Office

F358

1789	Over the past week I have been working on the vacation/handover sheets with the maintenance team in Sharjah and Dubai as they cleared apartments (mostly tenants).	*working on sheets *with maintenance again and again for better results	Inscription Redundancy
1790	I sent the final version (after 4 or 5 versions circling between	*4 5 versions *final version	Inscription

	me and AR) to AR, HN, and GPL.		
1791	HN called me and told me that she has some suggestions of her own.	*suggestions	Discussion
1792	We agreed that when we mee on Sunday we would work on it + revise the clause (she has done) that need to be there in the contract with [Software Provider 7 / SOFTWARE FF] based on a big full screen shots attachment they sent.	*meet to work *revise with me *full screen shots	Discussion Redundancy Inscription
1793	The attachment was a word file with almost all functions appearing as screen shots in process (in order of each module and in order of step by step).	*screen shots step by step modules	Inscription

F359

1794	Today [Software Provider 7 / SOFTWARE FF] also sent a proposed (software development in process) screen shots of 'Suppliers Profile' and 'Purchasing' function.	*proposed screen shots *new modules as required	Inscription Technological Extension
1795	This has not been there in the software. HN tells me that it has been designed with her on the phone! They stayed on the phone with HN as they create and mend the new modules.	*with her on phone *create and mend modules	Discussion Technological Extension
1796	HN: "They don't have the experience, it's like I'm telling them what to do!" I tell her maybe both of you are sharing ideas and she tells me she is haring more! And we laugh about it.	* sharing ideas	Discussion

Incidents 1797 to 1927 are omitted from this document. The full empirical record can be provided upon requesting the concerned party.

F402

1928	"It's all our effort " It took me sometime to remember the type of customization. I think they passed me in a lesson I have done during my bachelor (lesson? In a lecture? or maybe tutorial or maybe during my study?) years.	*remembering/lesson back in college	D
1929	I tell HN how could we have missed it! And she said because it shouldn't be our job: "it's all our effort".	*realization by discussion	D
1930	Regardless, these customization types are really a combination of our discussion and me remembering.	*realization by discussion	D
1931	Perhaps that's why they never came up, because we never discussed strategies of customization.	*realization by discussion	D

F403

1932	I tell HN I don't think these were exactly the types of customization, maybe they were something else (I can't remember clearly).	*cant remember clearly *opening chance for further knowing	D
1933	HN tells me regardless, these are important and "make sense" when we do customization strategy.	*make sense *customization strategy	TE

F404

1934	HN goes online and looks for other ways of categorizing customizations.	*searching online *other ways	In R
1935	There were various technical terms around the www that defines different customization strategies and customization methods; for e.g. visual, processing (flow), control,	*various customization strategies	TE

	feature coordination, interaction systems…		

F405

1936	We found a thesis online on software customization strategies (A Software Customization Framework by Jeffery William Michaud). On page 38 the summary is	*noting document	In

Type of Customization	**What is Customized**
Presentation	Information Architecture Graphical Content
Data	Format Content
Control	Feature Selection Option Specification Feature Addition Feature Addition Feature Enhancement Feature Constraint Feature Coordination

F406

1937	HN: "These customization types will mend our requirements".	*mend requirements	TE
1938	Now that we understand the types of customization, we understand how they will be fixed inside the system as our requirements.	*understand types of cuz = understand fix in sys	TE
1939	Meaning that they will be more practical in terms of what will work where, and how they will work, and how would we modify them so that they are more practical to code into the system.	*practical	TE

F407

1940	Meeting with YR from [Software Provider 8] :	*meeting	D R

1941	HN and YR discussing customization: we have a list of customizations but we cannot tell you all the customizations we need, we wouldn’t know, we are not sure and we need your expertise.	*topic *don’t know all we need *expertise	D
1942	YR talking about his experience with customizations: ”you need to give us space” – as in too much customization ‘wish list’ will crowd the system	*give us space *too much customizations	D R
1943	HN: “I want to minimize our work” “Now (the project)” “and later (using the software)” “Customizations should minimize our work, reduce efforts, reduce time..”	*min later customization as much as possible	D
1944	YR: “when I go through implementation, I don’t talk to you as a salesman, but as a technical person”. His way of speech and subject changes, he takes on a different personality: from someone who wants to sell, to someone who wants to make the product work.	*way of speech change *role taken change	D
1945	HN and YR going back and forth discussing charges of customization “there are certain areas which we can’t do [customizations], it will destabilize the product, it will create bugs” and that is keeping charges aside.	*back and forth discussing * excess customization = risk of destabilizing product	D R
1946	YR gives an example, an experience of a similar problem “I f I make this modification are you ready to scrap your system?”	*example	D
1947	“This is what I like about you, you are a technical guy and you are able to advice me and	*technical guy/advice/alternate ways/expert	D R

	explain to like we can do but we can do it this way" " yes, like alternative way" "yes you're expert in this I know, I just need to get something official from you to not increase price" (laughs)	*didn't stop to consider destabilization earlier	
1948	"But I really need a better graphical interface, a visually better one" I repeat MZ's example: click click click and I learn how to use the system. That simple, like an iPhone.	*graphic interface/visually/click/simple like iphone	TE
1949	Going through the [Software Provider 8] user manual and documents: "for e.g. I want this function to be under a different module" "yes this is configurable not customizable, configurable"	*going through sent manual in meeting *function under modules *configurable/customizable	TE
1950	HN: "I want to have an official confirmation about the customization, I don't want surprises" taking about costs "send me a draft for the statement of work" "we have level one, level two, level three implementation phases and for sure customizations will come and I want to reduce/limit those as much as possible"	*official confirmation *draft statement of work *use documents to cycle and reduce/limit surprises	In
1951	YR: There are a lot of factors affecting the upside/ downside of a project implementation and it will go through this cycle. I want to let you know that sometimes the downsides are so bad, you would want me to cancel the contract, but you shouldn't (is he cautioning us about something?). YR: by experience it will get better and better in time and it will surpass your expectations. So	*sharing experience *story *upside/down side of projects will happen no matter what *how to deal with it	D

	don't think about the future so much in details, let it happen. YR gave an example of a situation like this with a company that he worked on.		
1952	YR: "contracting between two companies is like marriage"	*metaphor	D
1953	YR: "my success is my design". The system is designed simple to use (HN and I disagree)	*design is simple *I disagree	TE D
1954	HN showing YR the visuals of other softwares (screenshots on physical papers) with company names redacted (scribbled over, removed, or hidden by thumb)	*visuals of other companies to enforce point that there are better visuals in market *physical paper	D In
1955	YR opens his laptop and shows us the new design he is working on the software (mainly dashboards) "new models" "prototypes".	*new design *prototypes	TE
1956	HN and I are impressed. They are nice (interactive, big and colorful) but these are just dashboards. What about the rest of the software? How easy is it to go through?	*just dashboards *rest of system?	TE
1957	YR: I have officially appointed (employed) designers. They will be working on the system as a whole.	*appointed specialized in designing	TE
1958	Colors and visual interface might slow down the [Software Provider 13/ SOFTWARE II]. Even if it is on 2 separate servers the[Software Provider 13/ SOFTWARE II]would be crowded with visual processing. (I disagree, not to the point where it hangs. I play a lot of video games and I know that for sure)	*making a point against visuals *unneeded, drawbacks will surpass its advantage *disagreeing. I know by experience	R TE

F408

1959	Mr. AAZ postponed the meeting to either Wednesday or Thursday. He would let us know beforehand.	*postpone meeting *will use time to know more	R

18/10/2016
Sharjah Office

F409

1960	HN going into deep details of the screenshots. She had decided to open the opplist again, and trace them one by one in depth.	*screen shots *open opplist again *one by one	In R
1961	HN and I also open CLERK and start creating a comparison list.	*creating comparison list	In

F410

1962	HN notes:	*noting	In
1963	1. File uploading – pictures aren't displayed in the same window in [Software Provider 7 / SOFTWARE FF]. In [Software Provider 8] the picture is embedded in the window.	*pic display in another window vs embedded pic (third promise)	TE
1964	2. PPM (planned preventive maintenance) is not defined as a tab in [Software Provider 7 / SOFTWARE FF]. In [Software Provider 8] PPM has its own module.	*PPM built as function vs. built as module (first promise)	TE
1965	3. Scheduling of PPM in [Software Provider 7 / SOFTWARE FF] shows no evidence that it is linked with assets, unlike [Software Provider 8] which shows 'Asset Register' within its PPM module	*modules interlinking (second promise)	TE
1966	4. Alert notifications: Available in [Software Provider 8] for many options such as due time,	*alert notification for various defined functions (third promise)	TE

	asset replacement, job finished, job unable to finish, due time for report etc. [Software Provider 7 / SOFTWARE FF] does not have all these varied options for alert notification		
1967	5. Scheduling can be exported into outlook calendar sheet in [Software Provider 8] ? Or is there any other option to get a calendar view for PPM?	*scheduling: calendar view vs. list view (third promise)	TE
1968	6. [Software Provider 8] has more in-depth details for asset management – it has depreciation, suppliers, reports, repair history, who is supply, notes ('Note Pad'). In [Software Provider 7 / SOFTWARE FF] it's just one tab defining assets. HN: "[Software Provider 7 / SOFTWARE FF] is basically empty, there's nothing inside"	*in depth details defined for functions * "nothing inside" *first promise	
1969	7. Project management module available in [Software Provider 8] : MZ had requested that we upload architectural drawings for Operations purposes. Operations like flat/shop expansions, redecorations, mergings, building etc. This is possible in [Software Provider 8] , but not in [Software Provider 7 / SOFTWARE FF]. The project management module can expand this 'maintenance digitization' project into 'operations digitization project' (of course minus the other facility management operations)	*project management module *different operations other than maintenance *better for future expansion	TE R
1970	8. Managing your third party contracts? How far? [Software Provider 8] has more intricate options that define the finer details.	*third party finer details	TE

Elements of Theory

Core Categories	Categories	Properties
1. <u>Inscription:</u> Organizational knowledge vs. Scientific knowledge	**1a.** Transcription	rough noting on physical papers (documents) or digital screens (word file, excel file, etc.) - to explain a point or to learn a point or to create a point or to co-create a point
		sticky pads on documents - sticky pads for updating, sticky pads for informing, sticky pads for reminding
		highlighting figures (numbers), doubts, things to change, things important - highlighting to compare documents, highliting to bring attention to others on something
		scribbles on documents mostly physical
		screen shots for better understanding visually, printing screen shots - scribbling on it while look at shots understanding them, evaluating them, comparing them
		sketches - drawings on documents to explain or understand
		red pen - to underline and use as a highlight to bring attention to certain points
		circling - bringing attention/ putting emphasis to certain words, numbers, diagrams etc. while explaining or understanding
		printing virtual documents to physical papers for better learning, co-learning, understanding. Physical papers are easier to transcribe on (to explain or understand) than virtual documents
		color printing - better, faster comprehesion, avoids confusion, many times documents come with color keys. Colors can be used to denote the beginning/end of section, to divide, to show tables etc.
		calculating to understand, calculating to explain- roughly on physical or digital papers - cost, budgeting, cost breakdown or calculating number of functions, modules, or calculating to create a selection criteria (a score system) etc.
		open windows side by side to compare or do execute many tasks at once, each window can do a different task, or each window can have different information on the same issue, side by side can help see the whole picture- can help better explain, understand, create, -co-create
		open documents side by side - similar to digital windows but physical documents for different information from different sources or same source.
		Don’t staple - freedom to move papers around while learning, understanding, explaining, co-creating
	1b. Cascading	Preparing documents/ finalizing documents/organizing documents
		integrating documents together from two or more documents
		dividing documents into sub documents for different purposes/ for different departments/

		making official - getting approvals for document, printing, hard covering, officializing
		categorizing/ arranging all rough work into a coherent readable format
		revising work done, making sure its ready to store, to share, to make official - editing
		building on, updating, making changes every now and then on documents (version 2, V.3, year 2016, year 2017 etc.)
		getting opinions, feedbacks, additional points from others - building on those opinions
	1c. Cycling	Using official document as references to create new documents
		sharing documents
		Storing documents/archiving
		Searching for helpful documents
		Brochures, proposals, contracts, statement of work etc.
		official use of documents / unofficial use of documents
		pulling information from different sources of documents
		Collecting documents as source of information
		Return borrowed document as a source for others
2. Technological Extension: The cyborg accountant	**2a.** System of Organization	Structuring data input
		Expandability - transformation of a software package into another one
		Scalability - how far can existing SoO be molded into business requirements- modifications, alterations -updates
		integrating / linking functions and modules
		Integrating a system of organization with another system of organization - directly or indirectly
		Agility is the ability of a SoO to be modified/molded without burning much effort
		Different SoO interact with same data differently and produce different results
		customization strategies: functional, structural, visual, architectural, technical
		bend data in favor of structure OR bend structure in favor of data
		one man ship
		Compartmentalization
	2b. Interactivity	simple and effective - no need to type - click click click- easy fast available - like an iphone
		functions necessary for work vs. functions that make work easier
		different SoO interacting in sync
		Live system
		visual data -calendar, click on pics/icons, tracking, KPI diagrams

		Dashboards interaction
		real time approvals, real time jobs update
		different ways of presenting data/ different ways of interacting with presented data
		Not just monitor and control, but also fast and simple monitor and control
		Immediate input/ input through different machines (computer, phone/ tablet/ etc.)
	2c. Calculator	Auto organization of data
		produce KPIs
		auto reporting
		auto updates/ auto reminders
		auto renewals
		forecasting backward/forward
3. **<u>Redundancy:</u>** Not just in repetition, but also in synergy	**3a.** Duplication	one job done many times over -
		duplication of data on three systems - learning this way by creating functions
		duplication of data digital and physical
		Create data sheet for items based on theory/ create data sheet for items based on practice
		different ways to collect same data: through store or around building
		many demonstration sessions done: 1st 9 sessions and 3 2nd sessions
		same data organized many times over
	3b. Coordination	one job by many people
		More than one person noting same information
		many interviews done for one objective - GPL - backend integration issues and linking issues
		co-creating software: user, technicians, and professionals of functions (like HR or finance etc.)
		paralysis by analysis
		Working on a project and finally not implementing it
		many sources of information for same information -
		scope of project keeps changing: FMPS and them CMMS
4. **<u>Discussion :</u>** Wittgenstein - knowledge is a product of languaging	4a. D&D	there are many instances of reasoning/concluding/ deducing / sense making/ infer / realize during D&D
		narration - lessons learnt - proverb – advices
		D& D are languaging tools that intends to acquire knowledge that is out of realization and/or awareness
		D&D rarely occur as separate conversational events
		D&D often end up not only in coming up with new concepts, but also giving terms/definitions to these new concepts. LLP calls this: formalization, modernization, standardization
	4b.	Views presented and defended

	Discussion	Discussion is not the passive debate meant to defend a view point. In order to successfully defend and maintain a view point one must build on it actively during the conversation
		argumentation dominant: Discussion often leads to arguing which often leads to knowing (rhetorical mode)
	4c. Dialogue	people are more open to new views new ideas and new explorations.
		Dialogue is not the passive sharing of knowledge within a conversation; rather it is the building on knowledge being shared within a conversation
		exposition dominant: Dialogue conversations lead to exposition which leads to knowing (rhetorical mode)

The memos presented next are only the most significate. The full empirical record can be provided upon requesting the concerned party.

STAGE THREE:
SORTING
Objective: *Generating a full theoretical outline/conceptual framework for write up*
Practice: *Reviewing, sorting, and integrating memos*
Process: *Reviewing, sorting, and integrating memos*

Concept	Memo
Discussion	When two or more people are engaged in discussion they are not just sharing knowledge, they are creating new knowledge
	This I also know from reading a lot about languaging.many thinkers and philosoohers consider language not just an act of expression of thought, but also a driver of thought (driver of ideas)
	discussion matter is not only what to discuss, but sometimes also how to discuss it. like which point to talk about first. What to ensure before jumping onto next point etc.
	incidents also show that before meeting, conversations are also planned, not just discussions. The difference is philosophical, but I think where the incidents are going, planning discussion matter is more relevant than planning conversation matter
	metaphors, analogies, examples, hypotheticals, and wishful are a good way to make a point or create ideas during discussions
	Incidents show that it is often that discussions turn coversation topics. It takes you from one subject to a new subject - from one idea to a new idea - without that new subject being planned to dicuss
	Sapir-Whorf – the language spoken influences the thinking process of the language speaker (linguistic relativity). In fact, the language spoken limits the thinking of the language speaker to boundary of the language itself (linguistic determinism).
	logic, rationality, creativity, imagination, sensing, intuition, instinction etc. are somehow distinctly linked to dialectic, rhetoric, narrative, exposition, argumentative, metaphoric, instructive et
	Discussion and dialogue: toit 2003 argues it's the only way to create knowledge
	there are many instances of reasoning/concluding/ deducing / sense making/ infer / realize during discussion
	discussion and dialogue and converation appear almost everywhere as prerequists to decisions and plans and ideas. It seems that discussion doesn't only create a sense of agreement, but is also responisble for the generation of ideas
	After reading peter senge's the fifth discipline, I realized that I have been wrongfully coding 'dialogue as discussion'. I now know the difference. It doesn't really matter because I will put them both under the umbrella term 'discussion and dialogue'

GAP	My idea is that new knowledge can be generated/formulated by the different ways of processing already known knowledge. And its precisely those different ways of processing known knowledge that Im looking for. This is what makes standard communicative and taxonomic knowledge various knowing ways. This newly generated/formulated knowledge is actionable and affects the project.
	Obviously, knowledge can be generated by many other means, like for example problem solving or in-field observations
	Aher, Leavy, & Byrne (2014): "the complete data are never given to a single mind… and can never be so given" so only technology has the complete knowledge? But that would be information and not knowledge??
	I like to use the term 'live information streaming' when I explain to my colleagues what knowledge management is. It's simple, yet it expresses the complexity of knowledge management system in saying 'live' meaning the real-life now, the present, not the past not the future, the present. It goes perfectly to explain 'knowing'
	A knowledge management (Information management) system is **communicative and taxonomic** mostly when: 1. Data entry is not immediate 2. Is run by disinterested passive analysts whose job is to manage assets of ‘knowledge’ (existing) 3. Is not live/ is not real time A knowledge management system involves **knowing acts** mostly when: 1. Data entry is immediate 2. Is managed by those who work with the knowledge that directly concerns them 3. Is live and real time Maria Jakubik, (2011) "Becoming to know. Shifting the knowledge creation paradigm", Journal of Knowledge Management, Vol. 15 Iss: 3, pp.374 - 402

	A lot of studies have attempted to bridge the gap between knowledge and knowing (Weick, cook and brown 1999, kolb 1984, Schon 1983, Bragd 2002 and a lot more). I do not intend to do that. In fact, I want to widen this dichotomy to create a deeper understanding of the knowing way in projects. This will lead me to uncover and establish the knowing processes in project management.
	Projects need to generate knowledge continuously over the project cycle that is not specified at the outset (Engwall 2002). Pre-given knowledge at the outset (plans, designs, risks, assessments, budget, scope, time) is always Incomplete. New things always emerge. Knowledge management needed. The normative understanding of projects is the application of pre-existing knowledge to resolve implementation issues and situations. That would require no knowledge management. However, a project is completed by learning the project over its lifecycle. Project execution is seldom just a process of implementations; rather it is a journey of knowledge creation (Engwall 2002). This approach anticipates learning activities over the project lifecycle rather than knowledge certainty at the outset. Project as an organization + project as a temporary undertaking= A project is a mode of organizing to accomplish a temporary undertaking.
	KM is studied as a social phenomenon (social theories), IT phenomenon (information theories), and information systems (cybernetics). I shall study it as purely as a knowing phenomenon (knowledge theories)
	Epistemology of practice: 1. social theories: communication, language, interaction, environment, dialogue, culture, engaging etc. 2. purely knowledge theories: thought modes, falsification, verification, resue, truth, etc.
	Knowing is: 1. Expanding one's knowledge base 2. Developing the ability to expand and use one's knowledge base Therefore knowing acts are those practices that: 1. Expands one's knowledge base 2. develop the ability to expand and use one's knowledge base
	Mode 1 and Mode 2 knowledge

Inscription	I'm starting to realize a significance to scribbling and jotting on physical papers. I think it makes communication better and it makes our activities easier and faster. Reminds me of boundary objects. Sapsed, J., & Salter, A. (2004)
	I just realized that the sticky notes on files were meant as an updating notes, updating on whats missing and whats available. Once updates are complete and these notes have done their job, they are torn away and thrown into the garbage
	We learnt from screenshots more than we expected to. Visuals are very powerful like that
	The inscription on the screenshot print outs look messy and incomprehensible to those other than HNand I. That is true of inscriptions; they are subjective and only intelligible to those who were involved in it.
	finalization of documents can be submitted digital or physical or both depeing on purpose
	feedbacks and opinions and decsions are processes of cascading in inscription
	In a lot of incidents we insist of physical papers. This is because physical paper is better/faster to draw/sketch/scribble/inscribe on, which is better to explain/describe and make a point
	There can be inscription digitally and physically. Digital inscription is more efficient when cascading and cycling, but physical inscription is more efficient when transcribing
	Inscription as an idea really started when I started comparing scientific knowing methods with organizational knowing method and I came across Bruno Lator's Inscription in 'The social construction of scientific facts'
	Incription was the easiest knowing process to observe and record. It was clear as sky and it occurred frequently
	inscription can be a collective activity. Inscription could be done in presence and participation of multiple inscriptors
	sometimes, like this incident, some documents are prepared specifically for rough noting. They are designed to enhance and organize one's rough notes
	interestingly enough, one can transcribe to explain as much as one can transcribe to understand
	inscription at its rough stages is rather unintelligible to other than the person or group who made them
	many incidents show that inscription is not just the sharing of ideas or the writing down of ideas, but is also is a way to come up with new ideas. Ideas pop when inscripting
	co-inscription is when many work on inscripting on one paper or digital screen Inscription is not just used for creating idea, but also for explaining ideas

Knowing Acts	Every time you shuffle around the same information, you create new knowledge
	it seems that for a set of data, the more you dig into it the more you know. You can shuffle it many times and it will still look different and produce more knowledge
	one can and often does nest the 4 knowing processes: using inscription for mediation, or replication in inscription or discussion in replication etc.
	The phrase 'going through' appears a lot too often in the field notes. Its bascially examining or studying or investigating knowledge on digital screen or phyisical papers
	It seems that one of the things that defines the kind of data to be extracted from a knowledge source is the purpose of using that knowledge. Different purposes can pool from one knowledge base and end up with different information
	The word 'wonder' seems to pop up every time there is a discussion going on. It also pops during inscription practice. And mediation and redundancy (55 times)
	The word 'idea' shows up every time there is redundancy, discussion, inscription, and mediation (120 times)
	Far too often all 4 knowing acts happen at the same time. During this duration however, one of these processes seem more obvious than others. I think that redundancy was the one process that is least obvious to discern. It is always hidding somehow
	Interact with _________ using __________to amplify a project's ability at knowing: documents: Inscription practice: Redundancy technology: Technical mediation People: Discussion
	I take latour to be an epistemologist more than a sociologist: laboratory life, science in action, the pasteurization of france, we have never been modern, pandora's hope, facing gaia. Latour was alienated from the sociologists society (anti-latour)
	all four knowing acts have one thing in common: they have no start point and no end point. Each knowing act can be started from anywhere and end anywhere
	KNOWING ACTS ARE THE DIFFERENT WAYS OF INTERACTING WITH VARIOUS KNOWLEDGE SOURCES.
Redundancy	All these logistics and protocols and bureaucracy are hindering the work progress. Too much to do before getting things done
	AR is telling me that its natural to face a lot of delays, specially with such a project. He told me that delays happen for many reasons. Things always keep coming up in a project. It was very surprising to me when he suggested that we could take advantage of these delays and use the time. he said we could re-arrange things, collect more information, or become more familiar with the project process. This is interesting as I have never seen anybody who looks positively at project delays.

	. Replication can come in many forms and for many reasons: knowledge reuse, editing re-editing, reusing same solution, using same interview questions, same demo many times, different FMSP companies, one job by many people, doing job to gain experience, for better focus of project, doing something the same way others did it to learn from them, etc.
	Redundancy: in projects redundancy always happens, whether called for (planned for some reason like backup or validation or duplication or many visits or many interviews) or uncalled for (unplanned unexpected meetings, integration/installation/exportation purposes). While redundancy looks like extra bureaucracy; it leads to amassing more knowledge)
	when does redundancy stop being useful and start being a matter of wasting time and energy?

	Nonaka's redundancy is not what I mean by redundancy. Nonaka's redundancy is the delibrate overlapping of knowledge. It assumes a presence of pre-existing knowledge that is useful to the organization, and is just oustide the circle of the minimum required knowledge for a project. My redundancy is the delibrate adding of extra steps/processes/procedures/resources within a project lifecycle as it goes on, that may seem unnecesarry and redundant. The reasons for adding these extra steps vary - validation, backup, phasing out, helping others, change of objectives etc. The way one observes these redundant steps are by: **replication of work** (same work donr again and again or same work done by two people), u**sing many people for a single job when it was possible for just one**, **meeting about an issue many times over, duplication of data in different systems**, work in series vs work in parallel etc. My redundancy generates knowledge and is therefore an act of knowing
	Redundancy practiced deliberatly for the purpose of amassing more knowledge is an act of knowing. Redundancy can be practiced for many reasons other than amassing knowledge
Research Methods	I don't think contacting customers would be a pleasant experience. No company would be willing to give information about the system they use and whether they recommend it or not. At best they would think you some corporate spy, and at worst they will call the police on you for disturbing
	HNseems a little bit withdrawn and reluctant from giving me more information. This is a bit odd because at first she was excited about my research and had asked me all these questions. More specifically she isnt Ccing me in emails and she isnt sending me the estimated life cycle of the project. Is she being cautious of me as a researcher? or as a project member? or both?! or none. Perhaps I'm just misjudging her
	I feel that HNis more open with me when im in my 'employee' mode and ess open when im in my 'researcher' mode. I think I know why. In my employee mode im very involoved in making comments, descisions, arguing etc. In my researcher mode, Im more objective and observant. Just questioning, wondering and noting. That makes HNfeel that Im detached from the project
	Im thinking that I could use mind mapping to help me produce my categories and sub categories from incidents as I go on with doing grounded theory
	One of the ways I validate my field noting is running it by the persons who were involved in it. for e.g. during the demos, after each demo I run by the vendors all the points I have written. I also compare my notes withHN's. This helps me not only in validation but also in connecting ideas. Same goes with AR meetings and other meetings
	Empirical research: I'm not looking at knowing as a result of social interaction, I'm looking at knowing as a result of interaction with knowledge sources
	When I think about it in a big picture, the different practices of knowing is the interaction with different knowledge sources: 1. Documents (digital or physical) - Inscription 2. Thing itself - Replication 3. Technology - Mediation 4. People - Cooperation (languaging) Maybe its not like that really. Nevertheless its a good analogy Ive drawn to help me stay focused on the core categories

Technological Extension	We are using Clerk to collect a lot of information. Does information collection need to be a restricted procedure? Like only for a specific reason (a restricted use) for a specific agreed upon purpose? Is this technical mediation in practice? Or technology-in-use? Latour, B. (1994). On technical mediation. Common knowledge, 3(2), 29-64., Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of technology in organizations. Organization science, 3(3), 398-427.
	How does live updates data entry happen? Sensors? Direct input? Relay input? All of the above.
	All modules of CMMS, ERP, HRMS, PMS, FAMS etc. have a mix of knowledge management functions and information management functions
	You can interact with scheduling work by scroll down date or you could do it on a calender visual. The calender visual will show you a sticky note with different colours according to job details. A scroll down date will show you a table with job details. I think this is the power of technology. Really what it does is extend your ability to 1. structure and 2. use knowledge. Same data can be presented differently depending on the kind of technology you use, and that affects how you approach data and that affects your knowing
	Going back through my notes and I get a thought: mediation is not just technological. Mediation is basically 'how you approach data': what data do you choose to include/exclude/change/alter/organize/structure/relate etc. That gives rise to knowing
	CMMS, CAFM, ERP are different platforms that interacts with the same data differently. And the different ways you interact with data generates different POV and so different knowing. This is mediation. Technological mediation in this case.
	Technology doesn't only allow control and monitor, it makes control and monitor easy and fast. That is why 'mediation' is almost always 'technical mediation'. Monitor and control to occur doesn't require technology, but is much more powerful with it.
	Different technologies mediates differently with same information. Every different mediation gives rise to knowing
	This very interesting idea came to me while I was chatting with SHD. He suggested that a software can do my work This thought means that a system can create an orginzation of data automatically by feeding it chunks and chunks of nonsensical data. It is nonsense of course, but as we discuss the hypothetical situation further, i grew more and more into understanding what a 'calculator' really means when HN said it. and I related it to mediation. The resulting idea was wonderful.

	How to do mediation: using the **same data** you can **create multiple calculators** for **variuos purposes**. The **primary promise** of a calculator is to organize broken knowledge: i.e. to create a system of organianization for a knowledge purpose (e.g. categories, sub catergories); the **second promise** is to aid in taking decisions: i.e. to make calculations for a purpose; the **third promise** is to display data easy and simple and interactive (ex. calender view, bring data to us, simple to navigate etc.). for better understanding the third promise, list MZ requirements

	there is also the option of multiple knowledge sources in view as opposed to the one knowledg source in veiw whether theyu come from the same digital screen or different ones. The more knowledge source views the better. But too much may be bombarding. I guess its really about simplicity of use of a system
	just like there are various knowledge soures and knowledge sinks, there are various knowledge representation methods
	one of the recurring themes of calculators is interactivity. Some calculators make it easy/fast/available to collect the information you need from them, while others require that one puts in extra effort. Interactivity is often stressed by higher management: the iphone example
	A system of organization can be created in different ways; including a way so that it makes work easier. I425 and I416: functions that are necessary, and functions that make work easier
	Given that technology extends our ability to do stuff (latour), mediation by means of technology is just that: an enhanced ability to create a system of organization of knowledge. Enhanced in terms of communication, speed, options, and calculations. document collection has shown the many different ways of enhancing a creatation of a system of organization

	. Digitization is an act of knowing. It is meant to create and increase: **1. efficiency of the system-of-organization** **2. efficiency of the calculator** **3. efficiency of simplicity of use**
	Latour's technical mediation is a social theory of actants: the gunman and the mangun. **Mcluhan's (1966) 'understanding media: the extension of man'** is a theory of technology that proposes the extension of man into a cyborg. It is in this in struggle for extension that knowing occurs

I. *Qualitative Document Analysis*

Objective: *Data triangulation & validation* Practice: *Collecting, arranging, and analyzing documents (soft & hard copies) related to the Digitization Project* Process: *Qualitative analysis to supplement saturated pre-defined codes*

Document Collection Table

#	Document	Status	Type	Access	Author (s)	Purpose
1	Material list	incomplete	spread sheet	softcopy	Maintenance team	Store items tracking
2	SSP5 Email chain		communication	softcopy	HN & UJ	Discussing SSP5 system
3	SSP5 CMMS brochure - small		brochure	softcopy & hardcopy	SSP5	Introducing provided system
4	SSP5 CMMS system screenshots		screenshots	softcopy & hardcopy	SSP5	Presenting provided system
5	XAX Email chain		communication	softcopy	HN & MZ	Discussion of requirements
6	CLERK SWOT analysis - V1	complete	Report	softcopy & hardcopy	HN & Ghassan	Determining requirements
7	SSP1 Email chain		email	softcopy	HN, KVV	Discussing SSP1 systems
8	SSP1 ERP System presentation		powerpoint	softcopy	SSP1	Presenting SSP1 ERP system
9	SSP1 All systems brochure		brochure	softcopy & hardcopy	SSP1	introducing all available systems
10	SSP11 Email chain		communication	softcopy	HN, Ghassan, & WKS	Discussing SSP11 system
11	SSP11 Work proposal - V1		proposal	softcopy & hardcopy	SSP11	system implementation work scope
12	SSP11 Work proposal - V2		proposal	softcopy & hardcopy	SSP11	system implementation work scope
13	SSP11 All systems presentation		powerpoint	softcopy	SSP11	introducing company & all available systems
14	SSP11 Work proposal - V3		proposal	softcopy & hardcopy	SSP11	system implementation work scope
15	SSP9 Email chain -1		communication	softcopy	HPR, HN, Ghassan	discussing SSP9 system
16	SSP9 System leaflet		powerpoint	softcopy	SSP9	introducing company & all available systems
17	Sample sheets - equipment management	incomplete	spread sheets	softcopy	internet (edited)	creating equipment management sheet for XAX
18	SSP3 Email chain		email	softcopy	HN & RHB	discussing SSP3 system
19	SSP3 Company Profile		profile	softcopy & hardcopy	SSP3	introducing company
20	SSP3 System overview		user guide	softcopy	SSP3	navigating and using the provided system
21	SSP3 Discovery guide		publication	softcopy	SSP3	introducing company & all available solutions
22	Demo schedule - V1		schedule	softcopy	HN, Ghassan	Schedule for demo sessions

23	Demo schedule - V2		schedule	softcopy	HN, Ghassan	Schedule for demo sessions
24	Selection Criteria -V1	incomplete	spread sheet	softcopy & hardcopies	HN	Criteria for grading vendors & their systems
25	Road map - V1	complete	powerpoint	softcopy	HN	project charter/ project proposal
26	Facilities management companies list	complete	Report	softcopy	HN	Select FMSP for interviewing
27	Email		communication	softcopy	HN	progress update
28	SSP10 Email chain		communication	softcopy	HN, SSL	Discussing SSP10 system
29	SSP10 System applications profile		publication	softcopy & hardcopy	SSP10	introducing company & all available solutions
30	FMSP1 Company Profile		powerpoint	hardcopy	FMSP1 Facilities Service	Introducing company and services provided
31	SSP11 CAFM System profile		publication	hardcopy	SSP11	Introducing provided CAFM system
32	FMSP2 Company Profile		publication	hardcopy	FMSP2	Introducing company and services provided
33	FMSP3 Company Profile		publication	hardcopy	FMSP3	introducing company factories & industries
34	FMSP4 Company Profile		powerpoint	hardcopy	FMSP4	Introducing company and services provided
35	FMSP4 Company Profile		publication	hardcopy	FMSP4	Introducing company and services provided
36	FMSP4 Company Profile		brochure	hardcopy	FMSP4	Introducing company and services provided
37	Road map - V2	complete	powerpoint	softcopy	HN	project charter/ project proposal
38	SSP7 Email chain		communication	softcopy	HN, ITD, & MH	Discussing Aladdin system
39	Road map - V3	complete	powerpoint & spreadsheet	softcopy	HN	project charter/ project proposal
40	SSP7 work proposal - V1		proposal	softcopy	SSP7	system implementation work scope
41	SSP7 work proposal - V2		proposal	softcopy	SSP7	system implementation work scope
42	SSP9 Email chain -2		communication	softcopy	HN, Ghassan, HPR, HRR	Discussing SSP9 system
43	SSP9 Company Profile		powerpoint	softcopy	SSP9	introducing company & all available systems
44	SSP9 BMS Profile		powerpoint	softcopy	SSP9	Introducing provided building management systems
45	CLERK SWOT analysis - V2	complete	Report	softcopy & hardcopy	HN & Ghassan	Determining requirements
46	SSP4 Systems modules flyer		flyer	softcopy	SSP5	Introducing provided modules for a system
47	SSP4 Email chain		communication	softcopy	HN, SBR	Discussing SSP4 system
48	SSP4 Base system profile		brochure	softcopy	SSP4	Introducing provided base system
49	SSP5 work proposal		proposal	softcopy	SSP5	system implementation work scope
50	SSP5 revised customization order		proposal	softcopy	SSP5	system implementation work scope
51	SSP5 FM system overview		powerpoint	softcopy	SSP5	Introducing provided FM system

52	SSP2 systems profile		powerpoint	softcopy	SSP2	introducing company & all available systems
53	Road map - V4	complete	powerpoint	softcopy	HN, Ghassan	project charter/ project proposal
54	SSP12 FM system profile		brochure	softcopy	SSP12	Introducing provided FM system
55	SSP6 Email chain		communication	softcopy	HN, AHP	Discussing SSP6 system
56	SSP6 work proposal		proposal	softcopy	SSP6	system implementation work scope
57	Selection Criteria -V2	incomplete	spread sheet	softcopy & hardcopies	HN	Criteria for grading vendors & their systems
58	SSP8 work proposal - V1		proposal	softcopy & hardcopy	SSP8	system implementation work scope
59	SSP8 work proposal - V2		proposal	softcopy	SSP8	system implementation work scope
60	SSP13 system profile		profile	softcopy	SSP13	introducing company & all available systems
61	Project Charter (Road map V- 5)	incomplete	report	softcopy	HN	full project plan
62	What to look for in CMMS		editorial	softcopy	SSP14	planning CMMS features
63	SSP13 work proposal - V1		proposal	softcopy	SSP13	system implementation work scope
64	Selection & Evaluation Criteria - V3	complete	Report	softcopy & hardcopy	HN	Criteria for grading vendors & their systems
65	Project Charter (Road map V- 6)	complete	Report	softcopy & hardcopy	HN	full project plan
66	Maintenance jobs flow - V1	complete	powerpoint	softcopy & hardcopy	HN	all maintenance operations presented as flow charts
67	SSP7 screenshots document - V1		Report	softcopy & hardcopy	SSP7	job flows presented in screenshots
68	Maintenance jobs flow - V2	complete	powerpoint	softcopy & hardcopy	HN	all maintenance operations presented as flow charts
69	SSP7 screenshots document - V2		Report	softcopy & hardcopy	SSP7	job flows presented in screenshots
70	Workflow customizations	complete	Report	softcopy	HN	detailed customization table
71	SSP8 work proposal - V3		proposal	softcopy	SSP8	system implementation work scope
72	Minutes of meeting		Report	softcopy & hard copy	HN	AR's system requirements
73	New maintenance jobs flow - V1	complete	Report	softcopy	Ghassan & AR	all maintenance operations presented as flow charts
74	XAX CMMS System Requirements & Prospects - V1	complete	Report	softcopy & hardcopy	Ghassan	full maintenance operations in details, and expected system requirements
75	XAX CMMS System Requirements & Prospects - V2	complete	Report	softcopy & hardcopy	Ghassan	full maintenance operations in details, and expected system requirements
76	XAX CMMS System Requirements & Prospects - V3	incomplete	Report	softcopy	Ghassan & AR	full maintenance operations in details, and expected system requirements
77	New maintenance request form - V1	complete	form	softcopy & hardcopies	Ghassan & AR	for registering maintenance complaints

78	New maintenance request form - V2	incomplete	form	softcopy & hardcopies	Ghassan & AR	for registering maintenance complaints
79	New Handingover/Vacating form - V1	complete	form	softcopy & hardcopies	Ghassan & AR	for registering handover/ vacating jobs
80	New Handingover/ Vacating form - V2	complete	form	softcopy & hardcopies	Ghassan & AR	for registering handover/ vacating jobs
81	New Handingover/ Vacating Report	complete	Report	softcopy & hardcopies	Ghassan & AR	Report on new form use and changes needed
82	Implementation Control Procedures	complete	Report	softcopy	Ghassan & AR	Implementation strategy of new system
83	XAX CMMS System Requirements & Prospects - V4	complete	Report	softcopy	Ghassan & AR	full maintenance operations in details, and expected system requirements
84	Complete customization list - V5	complete	Report	softcopy & hardcopies	HN, Ghassan, AR	all minimum required customizations in details
85	SSP8 work proposal - V4		proposal	softcopy	SSP8	system implementation work scope
86	KPIs test - 1	complete	Report	softcopy & hardcopies	Ghassan	using current data to test create KPIs
87	KPIs test - 2	complete	spreadsheet and graphs	softcopy & hardcopies	AR	using current data to test create KPIs
88	HN notebook		rough notes	hardcopy	HN	rough notes on project matter
89	HN notes on word file		rough notes	softcopy	HN	rough notes on project matter
90	Documents with scribbles (various)		rough notes	hardcopy	GPL, HN, Ghassan, AR, Vendors	rough notes on project matter
91	A4 papers with scribbles (various)		rough notes	hardcopy	GPL, HN, Ghassan, AR, Vendors	rough notes on project matter

Document Analysis Table

Core Category	Document(s) selected	Data Analysed
Inscription	D1	Sheet not yet fully formatted - There are multiple tabs and empty category cells. Materials registered are incomplete. Document was meant to register all materials in store 1
	D4, D67, D69	Screenshots printed out and scribbled on for study
	D6, D45	SWOT analysis re-reviewed and updated
	D11, D12, D14	IMSWARE work proposal changed three times due to new knowledge acquired and new agreement conditions
	D17	Various spreadsheets taken from internet and edited to create store items list. Newly created format is incomplete
	D22, D23	Demo schedule changed twice to be convenient for the project committee
	D24, D57, D64	Selection criteria list went through three cycles of improvements. The first version was known to be

		incomplete and needed a grading mechanism. The next versions were thought to be complete
	D25, D37, D39, D53, D61, D65	The project charter went through six cycles of updates and improvements. The first four were powerpoint presentations, the last two were reports. The first report was incomplete, the last one was complete
	D40, D41	Aladdin work proposal changed two times after new knowledge acquired and new agreement conditions
	D49, D50	Sunsmart work proposal had its 'customizations needed' section changed after new knowledge acquired and new agreement conditions
	D58, D59, D71, D85	Letosys work proposal changed four times over after new knowledge acquired and new agreement conditions
	D63	First version of synergy work proposal
	D66, D68	HN's maintenance job flows went through two cycles of improvements
	D67, D69	Screenshots printed out and scribbled on for study. Screen shots here has gone through two cycles of updates and improvements
	D74, D75, D76, D83	Document on new system expectations, functions, delivery, and implementation. This document went through three stages of updates and improvements and included many documents that were separate such as D73, D78, D80, & D82
	D77, D78	Maintenance request forms were for expected new system. The change has gone through two cycles of upgrade and improvements. More upgrades and improvements are expected.
	D79, D80, D81	handover/vacating forms were for expected new system. The change has gone through two cycles of upgrade and improvements. Then, a report was written on the new handover/vacating forms and how to use them.
	D84	this report was taken from D83 and updated and improved before making it a separate document
	D88, D89, D90, D91	Various handwritten or digitally types notes collected from scribbles on empty notebooks, word files, empty A4 papers, and printed out documents. As you flip to the next page on each of these documents, you could see the progress being made. Some of these documents contain one handwriting, some more than one. Some indicate clear calculations, reminders, and underlines, others show a struggle of understanding.
Redundancy	D1, D17	Both D1 and D17 were collections of spreadsheets from outside sources meant to be used to create an equipment management spread sheet for maintenance items. Both D1 &

		D17 sheets were worked on separately and unsuccessfully. Eventually they led to the successful creation of the items list in store.
	D2, D5, D10, D15, D17, D18, D28, D38, D42, D47, D55	Most email chains discussions were redundant. The same issue would be discussed again and again on one email chain - perhaps due to misunderstanding or not understanding altogether. This could have been talked over in one face to face meeting. However, the saved discussion content on these email chains were later used to compare matters and generate new ideas.
	D66, D68, D73	Maintenance job flows for the new system were first planned by HN alone in two versions. Then another separate version was created by AR and Ghassan. However, all versions were studied to create a new job flow. This was included inside D74.
	D71, D75	A customizations list was created by HN separately. Another one was created by AR and Ghassan as part of D74. Both lists were eventually used to create a complete customization list, which was then separated from D83.
	D86, D87	AR early on had created a KPI test on excel using data from the available system. The same method was thought of and used by Ghassan much later on without knowing of the previous KPI test. Eventually, the two set of KPI tests were compared which resulted in generating new ideas
Discussion	D2, D5, D10, D15, D17, D18, D28, D38, D42, D47, D55	These email chains clearly contain discussions about the project requirements, system capabilities, agreement options, and other such various project matters. Within one email chain, one can observe that as discussion progress, new ideas are being brought up.
Technological Extension	D1, D17, D77, D78, D79, D80, D81	These documents show a cyborg being designed to facilitate a higher potential of data input and storage. As the design progresses, it is evident that new ideas are being generated in the successive creation of these documents.
	D66, D68, D70, D73, D84	These documents show a cyborg being designed and created to facilitate higher potential in data collection and flow. As the design progresses, it is evident that new ideas are being generated in the successive creation of these documents.
	D86, D87	These KPIs are a test of the capability levels of the cyborg in action. There are many ways to group different functions and create a KPI. Every time a new KPI is created new ideas get generated. This is evident in the separately made KPI tests in two documents.
	ALL	The content of these documents show the struggle of aligning man and machine to become one. It is in this struggle that knowledge is being acquired