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USING COMPLEXITY THEORY TO EXPLAIN EMERGENT PROJECT MANAGEMENT PRACTICES

RESEARCH IN PROGRESS

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Abstract
When top-down traditional approaches to project management (PM) in large scale information systems projects are taken, they cannot fulfil the challenges of complexity exhibited in such projects. This research in progress argues that an alternative approach rooted in complexity theory should be taken. This study challenges the traditional views of PM, and seeks to shed light in understanding and managing emergent PM practice by turning our attention to Complex Adaptive Systems concepts of self-organisation, coevolution, and emergence. Specifically it investigates and attempts to explain PM practices observed in a state-wide e-Health Programme implementation. By using complexity theory and critical realist perspective, this study seeks to: 1) adopt the view that PM methods and practices are emergent in nature and can be explained in terms of self-organisation, coevolution, and emergence; and 2) employ complexity theory as the analytical framework for conducting the process of abduction to derive explanations of empirical practices.

Keywords
Complexity theory, complex adaptive systems, project management, self-organisation, coevolution, emergence.

INTRODUCTION
Implementation of large-scale information systems (IS) or technology-driven change (Markus 2004) has become a major trend in organisations. Despite both technical innovations and research advances over the past decade, the implementation of IS such as enterprise resource planning (ERP) systems, customer relationship management (CRM), supply chain management (SCM) systems, or other integrated suites of systems is still prone to some degree of failure. See, for example, industry reports by Robbins-Gioia (2001) and Darrell et al. (2002). The negative trend is further supported and emphasised by academic studies that are reporting similar stories (e.g., Gibson 2003; Robey et al. 2002).

Studies of large IS projects and implementation initiatives (e.g., Besson and Rowe 2002; Hanseth et al., 2001) highlight that current management perspectives are characterised by management control, deliberate project design and planning, commonly known as top-down, stepwise, and linear approaches to PM. However, in practice for example, enterprise systems implementation face issues of continuous change, uncertainty, unpredictability, and less control. These projects often display different PM practices and directions with changes along the way that often cause the outcomes to be quite remote from what was originally intended or expected to happen; that is, emergent practices (Hanseth et al. 2001). As a result, when top-down traditional approaches to PM are taken, they cannot fulfil challenges and requirements of large scale IS projects.

In reality large scale projects display characteristics of both business and technical complexity; that is, they deal with complex and ever changing organisational requirements and environments. They use a variety of technologies and have a high number of parties with divergent needs involved during implementations (Chae and Lanzara 2006). PM practices in such situations are complex activities that cannot be resolved or explained by stable, simple cause and effect solutions, linear predictability and reductionist approaches to management (Benbya and McKelvey 2006; Hanseth et al. 2001; McKelvey 2002).

In order to address the complexity inherent in such projects, a new perspective to PM should be taken. Specifically, this research in progress explores the case for considering concepts derived from complexity theory (CT) as new lens for investigating and explaining emergent PM practices in large scale IS projects. Such projects are characterised by high level of complexity and can be treated and conceptualised as Complex Adaptive Systems (CAS).
In taking a CT view, this study attempts to challenge the traditional views of project planning and control and seeks to suggest the need for new ways of managing emergent PM practices. It does so, by turning our attention to concepts of self-organisation, coevolution, and emergence. In studying large scale projects, there is therefore a need to employ CAS related concepts and search for explanations of PM practices based on far-from-equilibrium, dynamic, non-linear, and more holistic approaches.

Although considerable research has been conducted into PM, and specifically in IS environment, there is a need for further theoretically-grounded research to uncover emergent principles, methods, processes, and implementation aspects of PM in complex IS projects. This study takes a preliminary step in seeking to develop an in-depth understanding and explanation of emergent PM practices in complex IS environments. The following research questions are investigated:

1. How do project management practices take place in large scale (complex) IS projects?
2. What principles, methods, processes, and implementation aspects emerge in complex IS projects and do they facilitate or inhibit the management of such projects?

These research questions will be addressed by investigating current PM practices in a state-wide e-Health Program implementation in Australia. This study uses critical realist (CR) lens and employs qualitative research methods using abduction to explore current emergent PM practices and explain how and why these practices emerge in complex situations. By exploring emergent PM methods and practices, this study argues that evolutionary principles rooted in complexity theory have potential for developing a theoretical framework more suitable for managing complex IS projects. Knowing how and why emergent practices take place, project managers will have a better understanding of how to successfully manage such projects.

This paper is organised as follows. First, concepts and characteristics of complex adaptive systems are introduced as the theoretical background to the study. Second, the suitability of exploring emergent PM practices using complex adaptive systems is suggested. Third, the research methodology employed in this study is presented by highlighting philosophical assumptions, case study approach, data collection and analysis procedures. Last, expected contribution and potential limitations of the current study are highlighted.

BACKGROUND TO THE STUDY

In this section, first, key concepts rooted in complexity theory are introduced. Second, characteristics of complex adaptive systems (CAS) are presented. Third, a limited number of recent studies employing CAS to explain emergent behaviour are highlighted.

Overview of Complexity Thinking

Complexity is today one of the major features that characterises the world (Axelrod and Cohen 1999). To address and investigate complex phenomena, complexity theory (CT) has gained significant attention in recent times.

CT serves as a label for a number of theories, ideas, and concepts derived from scientific disciplines and revolve around a holistic bottom-up approach to understanding systems. CT is a relatively new embraced way of thinking about interactions of components in a system, such as groups, organisms, organisations, society and enables new views of examining and theorising organisational activities and behaviour (McKelvey 2002; Benbya and McKelvey 2006).

From an organisational viewpoint, CT proposes that organisations and other similar systems are dynamic and evolving entities. They are interdependent and best understood as complex adaptive systems (CAS) (see, for example, Bardzi and Reid 2004; McElroy 2003, Schneberger and McLean 2003; Xia and Lee 2004). Such systems encompass a high number of components and dynamic networks of relationships among their components (Hogue & Lord 2007).

Characteristics of Complex Adaptive Systems

A key feature of CAS is that they are open systems that interact with their environment, including other systems. During this interaction, CAS operate and change through evolutionary processes during which successive levels of structures emerge (e.g., cells, organisms, groups, organisations, societies, etc.) (Allen and Varga 2006).

CAS are systems far from equilibrium or stability because the maintenance or emergence of their structure always require and exchange energy with the environment (e.g., across system boundaries). CAS have potential for coevolution, that is, the change occurring in the context of the interaction with their environment (i.e., intersystem) (Allen and Varga 2006).

CAS also have the ability to self-organise. Self-organisation refers to change resulting from interactions within the system (i.e., intra-system). For example, within a company different people collectively arrange their roles
and functions, that is, they create a new internal structure. Self-organisation is the process that captures the capacity of CAS to spontaneously organise themselves into another structure needed to adapt and survive (Benbya and McKelvey 2006). Self-organisation takes place as a result of spontaneous behaviour and there is no clear guidance for how it occurs (Benbya and McKelvey 2006).

CAS allow emergent behaviours or solutions to arise; that is, they display “complex behaviour that emerges as a result of interactions among system components (or agents) and among system components (or agents) and the environment (Potgieter and Bishop 2001).” By advocating self-organisation and coevolution as key change processes, CT offers new lens for investigating emergent capabilities and features of CAS.

In CAS, interactions and feedback loops display a high degree of complexity and non-linear behaviour that traditional and well known predictive models fail to explain (Van den Bergh and Gowdy 2003). Analysing CAS means to incorporate variability, uncertainty, and nonlinearity. Consequently, researching CAS aims at improving our “understanding of how evolutionary processes and dynamic patterns emerge and interact across hierarchical levels, across different spatial, temporal and social scales” (Hartvigsen et al. 1998).

Because interactions in CAS exhibit nonlinearity and uncertainty, they are the main mechanisms by which small causes can generate uneven, structural changes, and organisational evolution (McKelvey 2002). This is sometimes referred to “butterfly effect” (Lorenz, 1963) where “a tiny effect of a butterfly flapping its wings could potentially change the emergent pattern of the large-scale atmospheric dynamics.” In other words, CAS’s behaviour is highly uncertain and difficult to forecast.

According to CT, history, luck, contingency, particular circumstances matter in organisational evolution. CAS are highly sensitive to initial conditions, events, and circumstances along their evolutionary paths (McElroy 2003). CT rules out forecasting about the future but in exchange offers an alternative way of thinking to linear fashions (Morrison 2010) that help researchers explain and theorize what has occurred and what is occurring, rather than what will occur. CT offers suitable lens that assist researchers explain and theorise but not predict organisational behaviour.

**Prior Studies Focusing on Complex Adaptive Systems**

CT and CAS propose theoretical concepts that explain change as emergent behaviour (Davis and Sumara 2005). Recent studies argue that CT and CAS concepts can support organisations in finding and facilitating conditions that promote an evolutionary approach to management, based on self-organisation, coevolution, and emergence (Bardzi and Reid 2004; Benbya and McKelvey 2006; McElroy 2003).

This view contrasts the traditional belief that organisations or organisational systems function in a top-down, controlled fashion, and it rather suggests a bottom-up, emergent perspective to their functioning and operations. According to CT and CAS, organisational systems/organisations should operate in a less controlled fashion and display higher levels of flexibility when managing their operations. Specifically, concepts of self-organisation, coevolution, and emergence should therefore be recognised in order for managers to identify opportunities and constraints that could improve managing the evolution of their various organisational forms (Benbya and McKelvey 2006).

CAS have gained popularity in recent years and a number of researchers have used CAS concepts for their research enquiries. For example, knowledge management scholars argue that knowledge develops and is shared by organisations in forms of CAS (Bardzi and Reid 2004; McElroy 2003). Englehardt and Simons (2002) suggest that CAS offer insights that help create learning environments and explain innovation and organisational learning as the transformation process from individual to organisation in which the primary forces are self-organisation and emergence.

Specifically in IS, Allen and Varga (2006) explain the coevolution of information systems (IS) with their organisational environments, by providing insights into processes that underpin the construction and development of IS. Benbya and McKelvey (2006) suggest that IS alignment display coevolution-based self-organised emergent behaviour and structure. The authors argue that CT provides important insights for dealing with the emergent nature of IS alignment. Vidgen and Wang (2009) propose a framework for organisation of agile software development grounded in CAS and draws on principles of coevolving systems. Their framework identifies enablers and inhibitors of agility and emergent capabilities of agile teams.

As briefly presented in above examples, concepts of CT and CAS have been successfully used in various research enquiries, including IS, to explain and understand organisational phenomena exhibiting emergent behaviour. Consequently, this study argues that large scale IS projects display emergent behaviour and CAS can offer an appropriate lens for investigating such projects to explain emergent PM practices.
EMERGENT PM PRACTICES INFORMED BY COMPLEX ADAPTIVE SYSTEMS

In general, large scale IS projects refer to initiatives involving organisational technologies and resources such as enterprise systems (Gailers et al. 2002; Gosain 2004) as well as information infrastructures (Hanseth et al. 2001; Howcroft et al. 2005). Such projects comprise and connect multiple groups of stakeholders within organisation or among a number of organisations (Braa and Rolland 2000). These projects tend to be conducted in a mandatory, top-down setting where initial decisions are made at the level of organisations or organisational units rather than individual users (Brown et al. 2002; Gallivan 2001). As they evolve, they are likely to involve several large groups of stakeholder with divergent interests and require large system specifications as well as various technical artefacts, tools, and resources (Bergman et al. 2002; Hanseth et al. 2001; Wagner and Newell, 2005).

Projects dealing with implementation of such systems involve high level of interactions among large groups of users with their own practices, often leading to a high degree of both intended and unintended behaviour and consequences. These heterogeneous socio-technical organisations and their interactions increase significantly the level of complexity in existing large scale IS projects and therefore display similar behaviour to CAS (Schneberger and McLean 2003; Xia and Lee 2004). Hence, the need to treat large scale projects as CAS when investigating how such projects are managed.

For example, PM activities can be affected by unanticipated events (e.g., a crisis situation occurs) and the project team must quickly react by re-assessing the current project situation. Consequently, a revised project plan might be developed, rather than continuing with the original stepwise, linear approach. In large-scale projects, due to their nature of complexity, it is observed that a chain of events and reactions usually occur as a result of such modifications. In other situations anomalies or conflicts can be thrown up in the formal PM process, and the project team and managers might find themselves in a need of encouraging informal structures to form. Thus, spontaneous or ad-hoc formation of workshops around particular issues or processes with membership drawn from various areas or business units, functions, or levels will arise; the project will therefore self-organise. In turn these informal structures and their interactions could lead to new assumptions and/or project trajectories that are potentially in conflict with the initial stepwise linear practices. While attempting to explain the emergence of new practices, attention should be also paid to project managers’ behaviours; that is, analysing whether management facilitates structures and environments where dialogue occurs and possibly leads to new innovative PM practices, rather than simply following the traditional, linear, stepwise PM practices.

As illustrated above, prior IS research has embraced CT and CAS to explain the emergent nature of processes such as IS development and alignment, where a number of PM practices could be observed. It naturally follows to suggest that exploring PM in large scale IS projects should turn our attention to principles of complexity thinking in order to offer researchers a workable set of concepts for explaining the emergent nature of what is observed in PM practices. The key challenges are to find out how to engage in the right emergent practices and identify the right capabilities of the project teams that would work the best in specific circumstances.

RESEARCH METHODOLOGY

Although empirical research drawing upon CT and CAS has been conducted in IS, less has been observed in the IS project management arena. An in-depth study to identify and explain current principles, methods, processes, and implementation aspects of PM in complex projects would therefore be beneficial.

Before conducting a research, researchers need to address their philosophical position, determine the methodologies they will employ, and justify their choices (Crotty 1998; Walsham 1995). First, critical realism (CR) is introduced as the philosophical perspective underlying this study. Second, the case study approach including an overview of the case site is presented. Last, data collection and analysis methods are suggested.

**Critical Realism as the Underlying Philosophical Perspective**

This study takes a CR perspective in conducting the research (Bhaskar 1978). CR has emerged recently as a philosophy of science underlying explanatory research (Danermark et al. 2002; Sayer 1992). CR has evolved as an alternative to traditional philosophical perspectives by focusing on explanation because it searches for structures and mechanisms that produce or cause things to happen (i.e., why things happen the way they happen) (Archer 1995; Danermark et al. 2002). Since this study seeks explanation rooted in CT, CR is considered appropriate. Below is a brief justification of using CR in this study.

The core ontological assumption of CR is that the world is objective, structured, stratified, and changing (Bhaskar 1979). CR is based on a “realist ontology” that suggests the reality is viewed and understood as a stratified and open system of objects with causal powers (Ackroyd and Fleetwood 2000; Bhaskar 1979; Danermark et al. 2002). In CR, reality consists of three domains: the real, the actual, and the empirical. Objects, which possess structures and mechanisms, are located in the domain of real. Mechanisms, when activated, may
generate events or patterns of events in the domain of actual. When identified and experienced by observers, events become experiences in the domain of empirical. This stratification implies that what happens in the world is not the same as what is observed as events. Researchers using CR operate in the domain of empirical but they cannot ignore the structures and mechanisms of the domain of real, which are manifested in the domain of actual (Dobson 2001). This is an important attribute of CR because CR penetrates the level of perceptible events to account for what occurs at the deeper level of reality, that is, seeking the real explanations for observations (Mutch 2002).

The stratified realist ontology distinguishes CR from both positivism and interpretivism. The latter philosophical perspectives are underpinned by “flat” ontologies, in which the three levels of reality are reduced to a single level, the domain of empirical (Ekstrom 1992; Reed 2000; Reed 2001). In contrast, CR studies seek to identify real causes in the domain of real, hence their key advantage to be used for developing explanations.

Further CR takes a view that empirical phenomena are emergent and operate in open systems. This is strongly aligned with CT concepts, hence its appropriateness in this explanatory study. In summary, by taking a CR perspective, this study seeks to develop an initial theoretical framework that will eventually emerge in a full theory focusing on explanation.

**Case Study Approach**

This study investigation focuses on PM practices as they unfold in a case study. Case study research is used to gain an in-depth understanding of the phenomenon under investigation (Yin 1994). Specifically, it is used because: 1) it is well-suited for investigating “a contemporary phenomenon in its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident” (Yin 1994), as in the examination of large scale IS projects; 2) it addresses “how” and “why” questions, for example “How do PM practices take place in complex IS projects?”; 3) it allows the conduct of a study in which multiple sources of evidence are needed, for example, observations, interviews, and documents; and 4) it is well-suited for exploratory and explanatory research that seeks to understand and explain how a process unfolds, in this case, the process of PM (Dube and Pare 2003; Yin 1994).

Longitudinal case studies are used when the phenomenon investigated and its impacts are dynamic in nature, evolve over time, and produce effects that can be better observed over time (Benbasat et al. 1987). Because the PM process unfolds in the context complex IS projects, the focus of our study is on understanding the dynamics these interactions this study seeks to discover new principles, methods, processes, and implementation aspects that facilitate or inhibit PM practices in complex situations (Darke et al. 1998). A longitudinal case study approach is the target approach to be employed in this research.

The use of a single case study here is justified as follows. First, a single case study is appropriate for studying a complex social process in which both experiences of individuals and the context of their interactions are critical. This is suitable for PM practices for large scale IS implementations (Darke et al. 1998). Second, because case studies are subject to replication rather than sampling logic, a single case study is equivalent to a single study of any other kind (Yin 1994). Third, studies using CR theorise from empirical descriptions to explanations (Lee and Baskerville 2003; Walsham 1995). Fourth, longitudinal, theory-building studies are typically conducted on a single case.

**Overview of the Case: e-Health Programme**

The current study seeks to uncover and explain new PM practices as they are observed during the implementation of a state wide *e-Health Programme* (a pseudo-name) in Australia. Below is a brief introduction to the case, followed by the research design of the current study.

The programme investigated in this study consists of a number of smaller, independent e-Health solutions that aim at improving the efficiency and effectiveness of health care delivery across an Australian state. These e-Health systems will represent means by which consumers, care providers, and health care managers will electronically interact with the overall health system in order to increase the quality of the health care in the region.

The overall aim of the e-Health Programme is to offer a centralised Electronic Medical Record (eMR) system that will allow clinicians and planners to have a single view of the patient records and will integrate with other key functionality systems such as, Medication Management, State-wide Scheduling, Order Entry and Results Reporting, Clinical Notes, Enterprise Discharge Summary, while coupled with critical administration and support systems (e.g., Patient Administration System, Scanning, etc.). The overall IS solution is to be implemented via a complex supporting infrastructure, connectivity, data centres, security, standards, information architectures, information policies, business intelligence tools, and so on.
The choice of the e-Health Programme implementation is suitable for investigating PM in complex IS projects because of the programme magnitude and its complex characteristics. The programme is driven and characterised by factors such as: 1) high level of complexity of the environment into which e-Health must be implemented; 2) relative immaturity of IS use within the sector; 3) high number of IS solutions that need to be both deployed and integrated (e.g., eMR systems, health care service delivery tools, health information sources and health care management systems); 4) high number of healthcare related stakeholders (e.g., consumers, care providers, health care managers) and vendor partners (e.g., vendor providers, consulting partners) continuously engaged throughout the program; and 5) high level of stakeholder involvement and change required.

Current Status of the E-Health Programme

The e-Health Programme had a start in 2008. Initial stages progressed slower than expected and currently, the implementation has reached various stages of progress, with the overall expectation to cover 60% of the state wide healthcare sector by 2013. An ambitious target, given that to date the programme is well behind the original schedules due to numerous delays in a number of roll-out stages. Specifically, to date, only a few individual e-Health systems have been implemented, or are in the process of being implemented, across the state with limited coordination, standardisation, or integration. Many of these solutions still face technical challenges such as the fact they are built on incompatible and often proprietary technologies, utilise inconsistent data structures and representations, and have not been built in a manner that supports information sharing or leverage by other care provider organisations.

The implementation of the e-Health solution was to rely on strong governance and apply rigorous project and change management methods with the main aim to successfully manage all significant project activities in a stepwise, top-down controlled style. To date, a number of significant drawbacks have been encountered, such as the project delays, lack of alignment with organisational requirements, lack of systems integration, major issues with coordination, poor communication, and overall decision making. These hurdles have lead to changes in project team as well as different trajectories from the original implementation plan. Lack of control and some tendencies towards a more flexible, bottom-up management style, driven by divergent needs of various stakeholder groups acting towards their goals have been observed and are considered new PM practices.

Such situations were not initially forecast and unexpected events and activities have arisen and they manifested in the form of self-organisation, coevolution, and emergent behaviour of the e-Health overall project. The case is therefore deemed an example of a critical case because it displays a very good example of a CAS with complex behaviour and a mix of activities that have roots in both traditional and emergent PM practices in organisations.

Data Collection Methods

As in other qualitative approaches, data for can come from various sources. Specifically, data collection procedures involve acquiring data through fieldwork such as: formal and informal interviews, observations, documents, audio and/or video materials, and other physical artefacts that appear to be relevant (Dey 1999; Strauss and Corbin 1998).

The researcher plans to visit the case site to conduct interviews, access secondary data, and obtain updates on the progress of the project. Once ethical clearance will be granted, a confidentiality agreement for accessing the case site and documents will be signed. After initial consultation and according to the signed agreement, it is expected that the researcher will: 1) have access to both project team and business stakeholders for formal and informal discussions, and to both internal and publicly available documents and/or materials related to the project; and 2) will attend relevant meetings and workshops. The variety of techniques used will provide the researcher with a rich set of data, which in turn, facilitates an in-depth analysis.

Interviews (open and semi-structured) will be conducted with major project team members (for example, programme director, change management manager, business analysts, other appropriate team members) and where possible managers of health care providers. In this way the researcher seeks to capture all potentially relevant aspects of the topic under analysis.

Data Analysis Methods

The study starts with an exploratory stage, and moves progressively into its explanatory stages as the investigation progresses and additional data is collected. Below is a brief introduction to how abduction is used to derive explanations in a CR study.

A key assumption of CR is that the underlying causes are not directly accessible to observation and have to be theoretically constructed through a process of conceptual abstraction, known as “abduction” or “abductive inference” (Danermark et al. 2002). Abduction, or “inference to the best explanation,” is a form of inference that moves from data describing something to a hypothesis that best explains or accounts for the data (Josephson and Josephson 1996).
Abduction is a kind of theory-forming introduced by philosopher and logician Charles Peirce to develop explanatory hypotheses as alternative to commonly used deduction and induction. To illustrate their differences, the main rules of deduction, induction and abduction are briefly discussed in Table 1. Note this is not an exhaustive discussion of the three modes of inference.

### Table 1. Modes of Inference (Reasoning)

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<thead>
<tr>
<th>Deduction</th>
<th>Induction</th>
<th>Abduction</th>
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<tbody>
<tr>
<td>Rule: All beans from this bag are white.</td>
<td>Case: These beans are from this bag.</td>
<td>Result: These beans are white (we have experienced that)</td>
</tr>
<tr>
<td>Case: These beans are from this bag.</td>
<td>Result: These beans are white.</td>
<td>Rule: All beans from this bag are white (we claim that)</td>
</tr>
<tr>
<td>Result: These beans are white.</td>
<td>Rule: All the beans from this bag are white.</td>
<td>Case: These beans are from this bag (therefore it is plausible and meaningful to hypothesise that)</td>
</tr>
</tbody>
</table>

Medical diagnosis, story understanding, languages learning are all abductive processes. Abductive reasoning leads to hypotheses or theories that are the best possible explanations. It has been argued that deduction does not necessarily lead to new knowledge, while induction will always display probable claims based on available data (Josephson and Josephson 1996). Abduction, by contrast, is the most creative act of reasoning from the experience to the case. It uses imagination, theories, and prior experiences to claim or develop hypothesised rules that are then verified with additional data. Abduction concludes with a critical evaluation in which a decision is made as to which explanation is best, according to the current settings and based on empirical data.

The process of abduction is the process of gaining knowledge about social reality by moving from a description and analysis of concrete phenomena (empirical observations of phenomenon X) to a reconstruction of the fundamental causes or explanations of these phenomena (e.g., explanation of X) (Danermark et al. 2002). Abduction involves “repeated movement between the description of particular empirical data and abstract analysis of the phenomenon under investigation” Sayer (2000). Abduction heavily relies upon existing theories as conceptual mediators for deriving explanations (Danermark et al. 2002). Such theories form a so-called “analytical framework” and they are usually used to guide data analysis and generate full explanations. Examples of theories used in abduction are formal theories such as complexity theory, structuration theory, or similar formal theories of social change.

However, developing a theory requires researchers to develop abstract categories and build relationships among the categories grounded in empirical data (Glaser and Strauss 1967; Strauss and Corbin 1998). To achieve this, this study will therefore use data analysis techniques that are rooted in grounded theory. Grounded theory was introduced as a qualitative research approach to uncover and understand what lies behind the phenomenon about which little is known (Strauss and Corbin 1990),” hence it is considered a suitable technique to be used in analysing the data.

To infer to the best explanations while employing an “analytical framework,” attention will be turned to Layder (1993). Layder (1993) suggests extending the “pure” grounded theory to a more “open” method that allows the use of formal theories during data analysis and theory generation. Specifically, complexity theory will be used as the formal theory for conducting abductive reasoning needed to generate the explanatory theory in this study.

### CONTRIBUTIONS OF THE RESEARCH

This study addresses an issue that is of major importance to organisations implementing large scale IS projects. It is expected this study will therefore make contribution to both research and practice. It seeks to equip us with a better understanding and explanations of current PM methods and practices, as well as to set up a new agenda for future research informed by complexity theory in the PM arena.

From a theoretical perspective, the major contributions of the study will be a grounded theoretical framework or theory that will improve our understanding of the emergent PM methods and practices in large scale IS implementations. By adhering to complexity thinking and taking a critical realist philosophical perspective this study: 1) develops a theoretical framework/theory that seeks explanation as its goal; 2) adopts the view that PM methods and practices are emergent in nature and can be explained in terms of self-organisation, coevolution, and emergence; 3) employs complexity theory as the analytical framework for conducting abductive reasoning/inference when deriving explanations; and 4) suggests complexity theory as a formal theory that supports the conduct of critical realist studies.
From a practical perspective, the major contribution of the findings will be a more realistic view of the PM in practice. With large scale IS being installed in organisations of all types and sizes, understanding how to manage these projects is essential to their successful implementations. Consequently, organisations should be in a better position to understand and prevent issues associated with implementing large IS projects, avoid costly and problematic implementations, thereby achieving benefits, and creating business value. Further, the study aims at integrating the findings into project management IS curriculum, and enhancing future students’ education by equipping them with a skill set required when engaging in complex IS projects.

Potential limitations of this study are: the investigation of a single case study and potential limited generalizability of the study findings. As discussed early in the paper, the focus of this study is to derive best explanations, not prediction or full generalizability of the uncovered emergent PM practice. With new avenues for future research, it is expected additional cases will be investigated to validate and achieve some degree of generalisation of the new emergent PM methods and practices.

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