Exploring Project Management by Exploiting Analogy with the Game of Go

By

E. Grant Kerr

A thesis submitted for the degree of

Doctor of Philosophy in Strategy, Programme & Project Management

SKEMA Business School, Lille

December, 2011

Supervisor

Pr. Dr. Christophe N. Bredillet, Centre for Advanced Study and Research in Project, Programme and Portfolio Management

Examiners

Dr. Derek Walker, Royal Melbourne Institute of Technology

Dr. Ginger Levin, SKEMA Business School

Jury Members

Dr. Rodney Turner, SKEMA Business School (Chair)

Dr. Laurence Lecoeuvre, SKEMA Business School

Dr. Mehran Azaran, SKEMA Business School

Dr. Mohamed Shihata, United Arab Emirates Embassy, Paris

Certificate of Authorship / Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student ________________________

Acknowledgements

There are many, many people who have helped me reach this goal of a completed PhD thesis. First of all, my deep thanks and respect to my supervisor Dr. Christophe Bredillet. Thank you to Dr. Janice Thomas and Dr. Lynn Crawford for helping me to find this path. Thank you to Dr. Rodney Turner, Dr. Philippe Ruiz, Dr. Paul Giammalvo, and other professors, staff, students and alumni of SKEMA Business School (formerly ESC-Lille) for their encouragement. Thank you to Shifu Yuan Zhou, my Go teacher, to Professor Jeong of Myongji University, to the members of the Regina Go Club, and to the writers of books for Go players, to professional Go players, and to teachers of the game of Go for exploring and pushing the limits of the game of Go, and communicating the knowledge gained from their experience. Thank you to co-workers, peers, students, friends and acquaintances who expressed interest and support for my work. Thank you to SAIC Canada for financial as well as moral support.

Finally, and most importantly, thank you to my wife, my children and my extended family for their ongoing love and encouragement.

Table of Contents

List of Tables

List of Figures

Abstract

The Engineering and Physical Sciences Research Council (EPSRC) funded a research program from 2004-6, informally titled *Rethinking Project Management*, because existing project management concepts were not meeting the needs of practitioners and industry. The program recommended research in several directions: theories of project management, a broader conceptualization of projects, value creation, reflective practitioners, and social processes. This thesis provides one contribution to that research. It uses 83 principles from the 4000-year-old Asian game of Go as the source of analogies with project management to identify similar structures, meanings, and purposes for characteristics of projects, of project managers, and methods for managing projects. 33 of the Go principles were found to already be standard practice in project management, 40 of them were known but not yet considered standard project management practice, three were considered to be not applicable to project management, and seven were not identified in current project management literature. In other words, these seven Go principles may be new to project management, and primarily deal with strong opposition to a project. The similarities between the game of Go and projects are identified and briefly analyzed from the perspectives of complex problem solving, game theory, and Taoism. Analysis of the results identifies a decision-making approach for dealing with change, uncertainty, weaknesses, and conflict in managing projects. Some characteristics for managers of complex problem projects are also identified.

This thesis provides new thinking about projects, project management and project managers. It adds a new perspective to current thinking on uncertainty. It

suggests that project managers learn to deal with enduring conflict. And it describes and provides examples of the use of analogy for new ways of thinking by researchers and by practitioners.

Keywords

Project management, uncertainty, complexity, change, conflict, analogy, decision-making, game of Go / baduk / weiqi, complex problem solving, game theory, Taoism

1 Introduction

The trigger for undertaking this research was the frustration I felt while trying to manage projects that had high degrees of uncertainty (partly due to loosely-defined requirements) with potential for significant and frequent change, with conflicting priorities from the significant number of stakeholders, and with many interrelated activities (and projects) - within the constraints of a traditional project management (TPM) perspective and support structure. I later realized that I was not alone and that many people were trying to address these concerns (Andersen, 2006; Bredillet, 2004c; Koskela & Howell, 2002b; Winter, Smith, Morris, & Cicmil, 2006), but there is no consensus yet on how to deal with these types of projects.

I noticed that some of the situations that occurred in my projects, and the solutions that were tried, resembled those that occur during a game of Go. The game is thousands of years old and has been studied professionally for hundreds of years. During this period numerous principles were developed to help deal with these situations. In this research I demonstrate that many of these principles can be transferred to, and used successfully for, managing projects.

1.1 Background of the Problem

This research has grown out of my frustration with the limitations of traditional project management when used on dynamic projects. Some writers have described these limitations.

1.1.1 Limitations of Traditional Project Management

Frame (2002) argued that traditional project management is broken. Its limitations are: inattention to the importance of the customer; a single-minded focus on a fixed set of tools; it ignores life after the project (operations and maintenance processes); and it has a constricted view of what project managers should be able to do

Morris (2002) reminded us that "research carried out at Oxford and in the USA in the 1980s showed that many of the factors that cause projects not to meet their schedule or cost targets are not covered by the PMBOK type model". He went on to say, "Much of the PMBOK material is helpful in managing projects, but is not sufficient to manage them successfully. This should be no surprise as focusing on execution alone, without due consideration to context and strategy, will invariably lead either to inappropriately selected objectives or inoptimal strategies for accomplishing them" (p.85).

According to Williams (2002), classical project management methodologies (a) can only deal with certain well-defined types of interactions, for example, a project network diagram can easily represent a finish-start relationship, but is not so useful for representing reciprocal interactions between activities; (b) are not easily extended to include uncertainty; (c) do not account for the systemic, holistic effects that are present in structurally complex projects, so cannot reproduce the effect that the whole is more than the sum of the parts; and (d) most importantly, certainly cannot deal with the sort of complex effects described when goal and methods uncertainty impact upon a structurally complex project: the perturbations, feedbacks and dynamics that are set up produce complex dynamic behaviour.

Williams (2004) listed several more problems with traditional project management. One, it is unsuited to projects under high uncertainty – exactly the situations in which projects are proposed. Two, frequently events arise that compromise the plan at a faster rate than that at which it is practical to re-plan. Another problem is that most organizations assume an optimistic, deterministic view of the world that is not justified. Finally, the elevation of the Guide to the Project Management Body of Knowledge (PMBOK Guide) to a standard implies to many that the way to address increased complexity and change is by applying more formality.

Andersen (2006, p. 27) stated "the traditional task-oriented approach developed originally for building and construction projects does not work for renewal projects". The assumptions of perfect rationality, perfect information and perfect self-interest are inappropriate for renewal projects.

Sutherland and Schwaber (2010) identified a number of weaknesses of the traditional waterfall method:

- it requires that the good ideas all come at the beginning of the release cycle where they can be incorporated into the plan
- it places a great emphasis on writing things down as a primary method for communicating critical information, but most of the time the documents are not read, and misunderstandings occur when read
- valuable insights often come at the end of the release cycle – the first time using the working product – when changes are most difficult and disruptive

- the product is condemned to be only as good as the initial idea, instead of being the best once people have learned or discovered new things
- humans are not able to predict the future
- it tends to foster an adversarial relationship between the people that are handing work off from one to the next
- it is not much fun
- products fall well short of expressing the creativity, skill, and passion of their creators

1.1.2 Calls for Change

Calls for new thinking about project management abound, as the following examples demonstrate. “The underlying theory of project management is obsolete” (Koskela & Howell, 2002b, p. 293). “What are needed, then, are new ways of looking at modern, complex projects, new models and techniques for analysing them, new methods for managing them--in fact, new paradigms to underlie our approach to them” (Williams, 1999, p. 272). “The challenge of research in project management today, I contend, is to build a broad, multi-industry, theoretically grounded, explanation of what is required to initiate and accomplish projects successfully” (Morris, 2000, p. 23). “Project management reform is required” (Laufer, 2009, p. 2).

1.1.3 New Ideas

Many researchers have accepted the challenge and have begun to advance new ideas. Some are proposing new ideas from “within” project management, some are using ideas from other fields such as complexity science, information technology (IT), and even further afield.

1.1.3.1 Extensions from Traditional Project Management

Laufer (2009) developed five basic principles, each described by three specific guidelines, and two meta-principles that apply to all the others. The five principles are: plans and control to embrace change, create a results-oriented focus, develop a will to win, collaborate through interdependence and trust, and update and connect through intensive communication.

Frame (2002) recognized that most of the features of traditional project management are still relevant, but needs to be enhanced to bring it into line with the new business realities by: becoming more customer-focused, exploring the use of new management tools, and redefining the role of project managers to be more customer-focused and empowered to operate effectively.

Bredillet (e.g. (2004a, 2004c) advanced the theoretical underpinning of the management and analysis of projects (MAP) method originally developed by Declerck & Eymery (1976) integrating positivist and constructivist paradigms. This method requires decision-makers and analysts to work together to resolve poorly defined strategic problems using a three-phase process: choose a strategy, choose the tactics, and realisation.

Koskela (2000) developed the Transformation, Flow, Value (TFV) theory of production which Koskela and Howell (2002b).used to develop theories of project and project management. Koskela & Howell (2002a) then analyzed two constructivist methodologies (Last Planner and Scrum) based on the TFV theory, identifying areas where they could be improved.

J.R. Turner (2007a) proposed a comprehensive theory of project management, developing 21 conclusions and identifying eight roles, to address some of the shortcomings of earlier theories that were implicit or based on numerous assumptions.

Andersen (2006) argued that a general theory of project management is neither feasible nor desirable, but recommended theories for different types of projects. In his research, he suggested a number of propositions for a theory of renewal-type projects.

Morris (2002) also argued that there cannot be a single theory [of project management], but that there should be multiple theories because project management, like management itself, is too broad a subject for there to be a single theory.

The Engineering and Physical Sciences Research Council (EPSRC) funded a research programme from 2004-2006 to extend the current field of project management beyond its current conceptual foundations (Winter, Smith, Morris, & Cicmil, 2006). Their work was summarized in a special issue of the International Journal of Project Management (Volume 24 Issue 8 November 2006). The research network that was established (EPSRC Network, or sometimes Rethinking Project Management Network) identified current conceptual approaches:

- The dominant strand is the rational, universal, deterministic model emphasising the planning and control dimensions of project management. It fails to adequately deal with the emergent nature of front-end work, treats all projects the same, and does not account sufficiently for human issues.

- A second strand focuses on organizational structure as a means of achieving integration and task accomplishment
- A third strand emphasizes a broader view of projects, i.e. context, front-end work, strategy, learning, and managing exogenous factors in addition to the endogenous ones.
- More recent perspectives such as exploring the interplay between projects and the strategic direction of the business enterprise
- Projects as information-processing systems to address the uncertainty which is an over-riding characteristic of projects
- Exploring projects from a critical management perspective (e.g. viewing projects and project management as instruments of control)

The EPSRC Network recommended research in these five directions:

- Theories of the complexity of projects and project managements
- Projects as social processes
- Value creation as the prime focus
- Broader conceptualisation of projects
- Practitioners as reflective practitioners

1.1.3.2 New Ideas from Complexity Science

Some authors have used complexity science as a productive source of ideas to apply to project management.

Cicmil, Cooke-Davies, Crawford, and Richardson (2009) offered the concept of complex responsive processes of relating in organizations (CRPR), shifting from the predominant rationalist, normative, control paradigm towards one that embodies actuality, relationships and decision-making in uncertainty.

K. A. Richardson, Lissack, Tait, and Roos (2001) applied to project management the framework presented in the book *The Next Common Sense* by Lissack and Roos, which recommended 10 building blocks and five steps to customize for each project situation.

In the "Beyond the Frontiers of Traditional Project Management" research program, the researchers used complexity theory and many related theories (general systems theory, cybernetics, systems dynamics, grand evolutionary systems theory, brain research, sociobiology, dissipative structures, Transclassical logic, neural networks, social systems theory, evolutionary epistemology, constructivism, and others), documented in Saynisch (2010a), to develop a new paradigm for project management.

Dombkins (2007) included much of the background that eventually became *Complex Project Manager Competency Standards* (Defence Materiel Organisation Australia, 2008). Whitty & Maylor (2007) identified these concerns with the standards: the definition of complex does not stand up to any scrutiny; there has been no analysis of the problems that the establishment of this initiative is intended to solve; the process by which the standard has progressed has gone un-checked; and the standard is not established on evidence based practices. They go on to recommend some excellent research questions that would go far to appease academics regarding the standards' foundations and applicability.

Loch, De Meyer, and Pich (2006) focused on types of uncertainty and how to deal with them. These are discussed later in this document.

1.1.3.3 New Ideas from Information Technology (IT)

The information technology (IT) field has dealt with these limitations of TPM for a long time, and out of frustration with the existing paradigm a number of practitioners developed a different way of thinking about software development projects. This was documented in the Manifesto for Agile Software Development[1] (frequently shortened to "Agile Manifesto") in 2001. The paradigm has since been applied beyond software development, so a broader set of values was documented in the Declaration of Interdependence[2] in 2005. Some authors from this perspective are: Highsmith (2004), who wrote one of the first books dedicated to agile project management; DeCarlo (2004) who wrote the book on extreme project management; Schwaber (2004; 2002) explained the SCRUM method and some of the philosophy behind agile processes; Boehm and Turner (2004) provided an early attempt to explain agile methods to non-agile

---

[1] www.agilemanifesto.org

[2] www.pmdoi.org

practitioners, to compare traditional and agile methods, and then to compare quite a number of different agile methodologies (e.g. scrum, lean development, dynamic systems development method (DSDM), rational unified process, and others). More recently, Wysocki (2009) thoroughly explains five project management life-cycle models ordered by clarity of requirements: traditional-linear ("waterfall"), traditional-incremental, agile-iterative, agile-adaptive, and extreme.

1.1.3.4 New Ideas from Other Sources

A very few have used other sources of ideas to analyze project management. Hawkins and Rajagopal (2005) looked at project management using Sun Tzu's 2500 year old classic work *The Art of War*. DeFillippi and Arthur (1998) compared project management with film-making. Douglas (1996, 1998) used the game of chess to introduce project opening and closing concepts. Ireland (2009) did a slightly more in-depth comparison between chess and project management. A group of authors have recently looked at projects throughout history searching for lessons that can be applied today (Byrne, 2011; Kozak-Holland, 2005, 2007, 2009, 2010; Manas, 2009).

1.2 Statement of the Problem

As can be seen from the previous section, traditional project management is not meeting the needs of many projects and project managers. It is limited by its rationalist, determinist, normative, first-order control paradigm. It does not sufficiently consider context, strategy, irrational decision-making, nor does it deal with effects of goal and methods uncertainty such as high rates of change and reciprocal interactions between activities.

1.3 Purpose of the Study

Bredillet observed that project management is in a pre-paradigm state (Bredillet, 2004a). Kuhn (1996, pp. 61-68) indicated that during this period new ideas are needed to point the way to new discoveries and new theories. This research provides some new ideas and new ways of thinking about projects, project management and project managers, based on the game of Go.

1.3.1 Research Objectives

Traditional project management does not very well handle high degrees of uncertainty and high rates of change while dealing with conflicting priorities and many interrelated activities. Players of the game of Go must deal with these same factors. The game is thousands of years old, and has been studied professionally for hundreds of years. During that time principles have been developed to help deal with these factors. I demonstrate that many of these principles can be transferred to, and used successfully for, managing projects, by

- identifying the characteristics of the game of Go, and therefore of projects to which the remainder of the research applies,
- identifying some of the means for playing a game of Go, and therefore for managing projects, and
- identifying some of the characteristics of Go players, and therefore of project managers.

1.4 Research Questions

The questions to be addressed by this research are:

1. What can we learn about the nature of projects from the game of Go?
2. What can we learn about managing these types of projects from the game of Go?
3. What can we learn about the characteristics of project managers from Go players?

These questions are general and open-ended to prevent limiting the potential learning from the study.

1.5 Significance of the Study

Projects are the tool for implementing strategy in organizations (Morris & Jamieson, 2005; Project Management Institute, 2008b; Shenhar, 2004). But most projects fail to deliver their proposed value, e.g. "project success appears to equate to achieving an acceptable level of failure or minimizing lost benefits" (KPMG, 2005, p. 17). For organizations this means wasted time and resources, and for the people working on projects it means wasted creativity, skill and passion (Deemer & Benefield, 2008).

The project management context is becoming more complex and more uncertain – perhaps because the world is changing at a faster pace than in the past (Frame, 2002; Hillson, 2009), or perhaps because our understanding of the world is evolving (Saynisch, 2010a). Either way, traditional project management methods are no longer adequate and new perspectives are needed to develop new methods. This research provides an additional perspective on project management – from the game of Go.

1.6 Conceptual or Substantive Assumptions

I am a professional project manager and a long-time amateur Go player. When I manage projects, I sometimes perceive situations that seem to be analogous to those that occur during a game of Go and that I can apply Go principles. Here is an example from my experience illustrating the use of several Go principles (indicated by (Gxx) – their identifier in the tables of Go principles (see Table 10 and Appendix A)). The company I was working for had a small part (subcontractor to a subcontractor) in a particular project. The politics between the stakeholders was not good. The project manager was not enthusiastic about the likelihood of success of the project. After attending a couple of project meetings where there was a lot of talk but little action or documentation, I saw an opportunity to improve the odds of success ("take advantage of opportunities " (G17)). With the approval of my manager, I produced a high-level project plan for the next meeting ("Use probes to gather information about the opposition's intentions" (G67)). With this we were able to focus attention on what was important, who would do what, etc. and we used it going forward. Even though this project was small, the relationship with the stakeholders that success could bring made the project very important to our company. We had to push each of the other project team members to participate to the level to which they claimed to be committed ("constantly push the opposition to achieve the goal" (G32)). Some participants were so obstructive that they refused to participate unless we paid extra to use special parts, etc. Ordinarily we would not have given in to those demands, but because of the importance of this project (and the demands were not illegal) we went along with them ("Sacrifice something for something else that is bigger" (G59) and "Build influence to create value later" (G74)). I had to maintain the perception that the project manager was the project manager, so I had to be particularly careful to balance when I would lead and when to follow his lead ("Balance leading and following" (G69)). The project did meet its objectives and timeline, but only because I followed these Go principles.

1.7 Research Design

This research uses analogy as the methodology. One definition of analogy is "inference that if two or more things agree with one another in some respects they will probably agree in others"[3].

Analogies are intended "... to better understand a difficult topic. In some cases, they can lead us to look at a topic or idea in a new way - one which may lead to new insights which prove valuable to our understanding of the topic." (Connelly, 1996). The difficult topic in this research is project management. The intention of this study is to look at project management in a new way, i.e., from the perspective of the game of Go, leading to new insights.

This study uses the Multiconstraint Theory (MT) proposed by Holyoak and Thagard (1995), which consists of four steps:

1. Selection: select a source analogue

---

[3] Analogy. 2010. In *Merriam-Webster Online Dictionary*. Retrieved Oct 5, 2010, from http://www.merriam-webster.com/dictionary/analogy

2. Mapping: map the source to the target and thereby generate inferences about the target
3. Evaluation: evaluate and adapt these inferences to take account of unique aspects of the target
4. Learning: learn something more general from the success or failure of the analogy

The source analogue for this study is the game of Go. The following introduction to the game of Go is from the American Go Association website (Fotland, 1996):

> Go is a fascinating board game for two players that originated in China more than 4,000 years ago. It is also known as baduk, wei ch'i, weiqi, and igo. In Japan, Korea, China, and Taiwan, it is far more popular than chess is in the West, and professional players compete for large cash prizes.
> Two players alternate in placing black and white stones on a large (19x19 line) ruled board, with the aim of surrounding territory. Stones never move, and are only removed from the board if they are completely surrounded. The game rewards patience and balance over aggression and greed; the balance of influence and territory may shift many times in the course of a game, and a strong player must be prepared to be flexible but resolute. Go can teach concentration, balance, and discipline. Each person's style of play reflects their personality, and can serve as a medium for self-reflection.

In an internal Chinese Weiqi Institute document (as cited in Papineau (2001, p. 37)), "Zhang Yunqi lists the qualities required to excel at weiqi: the tactic of the soldier, the exactness of the mathematician, the imagination of the artist, the inspiration of the poet, the calm of the philosopher, and the greatest intelligence".

The game of Go has been used as a source analogue for many disciplines, e.g. military (Go, 1942), politics (Boorman, 1969; Kissinger, 2004), business (T. Anderson, 2004; Jeong, 2007; Miura, 1995), and mathematics (Conway, 1976).

1.8 Thesis organisation

This thesis is a little out of the ordinary, and its approach is also a little unusual. Chapter two consists of a literature review sufficient to provide the background for discussions which follow. Sometimes relevant literature is discussed elsewhere – in another appropriate context. Table 1 provides a list of major topics and their locations in the thesis. Chapter three justifies and explains the use of analogy, which is applied and described in chapter four. Chapter five continues the learning phase of analogy, analysing and interpreting the results of the analogies in several ways. Chapter six concludes the thesis.

Table 1. Major topics discussed and their location in the thesis

Topic of literature cited	Relevance to this thesis	Chapter
Project management theory	To understand traditional and emerging trends in project management thought	2
Go theory	To understand the source of comparison used in the analogies	2
Analogy	To understand the primary research methodology used in this thesis	3, 4
Decision-making	To understand its use in both Go and project management, and as a framework to discuss dealing with other topics	2, 5

Topic of literature cited	Relevance to this thesis	Chapter
Uncertainty	To understand current thinking about uncertainty and how to deal with it	2, 5
Conflict	To understand current thinking about conflict and how to deal with it	2, 5
Change	To understand current thinking about change and how to deal with it	2, 5
Taoism	One way of perceiving and dealing with the world applicable to both Go and project management	2, 4
Game theory	One way of perceiving and dealing with the world applicable to both Go and project management	4
Complex problem solving	One way of perceiving ad dealing with the world applicable to both Go and project management	4, 5
Characteristics of Go players and project managers	To understand some of the characteristics of successful Go players, and their applicability to project management	2, 5

For the discussion in chapter five that includes Go principles, the references and discussion included in the associated Go principles from Table 10 are also implicitly included.

1.9 Limitations and Delimitations

Limitations are things over which one has no control, such as bias, and delimitations are things over which one does have control.

1.9.1 Limitations

My understanding of the principles of the game of Go is not as sophisticated as that of a professional-level Go player. This has been mitigated somewhat through reading books and through discussions with my Go teacher, Yuan Zhou 8D.

1.9.2 Delimitations

The following questions or research areas are outside the scope of this work:

- Go principles that do not have an obvious analogy with project management
- Go principles from other sources
- Project management principles that do not have an obvious analogy with the game of Go. For example, how to deal with human beings, how to deal with organizations, how to deal with people in organizations, i.e. this is not a complete theory of project management
- Comparison of traditional project management (or Agile or any other approach) with game of Go
- Explain theoretical foundation for project management principles, or address questions such as: Which project management principles apply when (e.g. when & why is waterfall appropriate? Agile? Extreme?)
- Explain Go-based project management principles using systems theory or complexity theory (See Saynisch (2002), as referenced in Saynisch (2010b), for this – but it's in German), or game theory, or decision theory, etc.
- Comparison of various project management principles, methodologies or approaches
- Proof of applicability - analogy is for developing ideas, theories, etc., not for proving them
- How to play Go

1.10 Expected Contribution

Using analogy between the game of Go and project management, I identify characteristics of a particular type of project, identify characteristics of project managers, and demonstrate how project managers can deal with uncertainty, complexity, conflict, and change.

This research contributes to theory by:

- providing a different perspective on projects, project management and project managers
- describing a management method that incorporates both positivist and constructivist paradigms
- demonstrating the use of analogy for incorporating ideas, theories, etc. from other fields to project management or to specific project situations

This research contributes to practice by:

- providing a unified set of principles that can be used to accommodate uncertainty, complexity, determinism, conflict and change

1.11 Definition of Terms

In this research I use Wysocki's (2009) categories of Traditional project management referring to linear (i.e. waterfall) and incremental methodologies, and Agile project management referring to iterative and adaptive (e.g. adaptive, scrum) methodologies. Extreme project management refers to eXtreme project management as used by Wysocki (2009) and De Carlo (2004).

Table 2 provides descriptions of Go terms, and Table 3 provides descriptions of other terms used in this research

Table 2. Glossary of Go terms

Term	Description
Aji	The latent possibilities that exist in a position (literally, 'taste'). Although these possibilities may not be realized, their existence influences the course of the game and enables certain moves to be made.
Atari	Literally, 'hit'. A move that leaves an opposing stone or group with only one liberty. A player may announce 'atari', similar to announcing 'check' in chess.
Dead	A state in which stones cannot live (cf. 'live'). Stones taken from the board when their last liberty is filled are call 'captured'.
Endgame	A series of moves that ultimately decides the outline of territory. It is usually played at a closing stage as the term itself says, but also can be played at anytime during a game.
Eyes	An empty space or intersection in a player's group where the opponent can neither play nor force it to be filled.
Gote	A move which does not require the opponent to answer; a position in which one is forced to answer the opponent's last move.
Haengma	Considers a placement of a stone as a movement in relation to stones already played.
Handicap	If the players differ in strength, the weaker player puts stones on the star points before the game starts to compensate for the difference, i.e. to have an equal chance to win.
Honte	Proper play, a play that is correct for a situation, rather than obvious.
Joseki	A formulaic sequence of moves which is established for giving equal outcomes to both players. It includes related patterns that share its characteristics or core move.

Kikashi	A move which requires an answer by the opponent and gains some advantage even if not followed up immediately.
Ko	A situation where a stone is in atari as soon as it captures and apparently can be recaptured by the opponent. However, the opponent's recapturing stone also is in atari, so it can be recaptured. The ko situation can endlessly repeat in this way. In Go, therefore, the rules forbid immediate recapture.
Ko threat	A move used in fighting a ko that forces the opponent to answer instead of ending the ko. If the opponent ignores the ko threat the player takes the profit made from the threat; if the opponent defends, then the player recaptures the ko.
Komi	Compensation points added to one side's territory at the end of the game. Typically 5.5 to 7.5 points are added to White's score in an even game to compensate for the disadvantage of moving second.
Ladder	A zigzag sequence in which one side keeps giving atari to the other until the stones are driven to the edge of the board or into friendly stones and captured.
Ladder-breaker	A stone that is located in the path of a ladder that makes it invalid.
Live	To meet the requirement of stones not to be killed (become dead). There are three basic ways for a group to live: (1) to secure enough area to survive an invasion, (2) to have two separate eyes, (3) to make seki
Light	Stones with a light, flexible shape which can easily be looked after, or stones which have served their purpose and can be discarded without ill effects.
Ma-ai	Proper distance [source: (T. Anderson, 2004)]
Moyo	Framework; A territorial outline, made up of several strategic points that can become actual territory as the game continues.
Opening	The initial stage of the game where the players place stones in preparation for middle-game fighting and for making territory.
Prisoners	Captured stones that have been removed from the board.
Ranka	Literally, 'rotted axe handle'. A literary name for the game of Go.
Reading	To analyze a position and anticipate the results of moves
Seki	Shared life, dual life. A situation in which neither of two groups of opposing stones has two eyes, but neither side can attack the other without losing its stones.

Sente	Initiative; a move that requires the opponent to answer; the privilege of not having to answer the opponent's last move and being able to choose freely where to play next.
Star points	Any of the nine points on the board that are marked with a dot and on which the handicap stones are traditionally placed.
Stones	The pieces used to play Go. In expensive sets the white stones are made from clamshell and the black ones from slate.
Territory	A part of a board that is surrounded by stones of the same colour with no enemy stones alive inside it. Territory is the only factor that decides the result of a game. Territory can also refer to the territorial framework that is not completely surrounded, or 'potential territory'.
Tesuji	A skilful tactical move
Tewari	A way of analyzing the relative efficiency of plays. The process is: first take away an equal number of stones of both colours from a position. Then evaluate whether the remaining stones are working efficiently in order to decide which side made the better moves. Secondly, the order of plays is inverted to see whether one would still have played in the same way so the actual position results. This reveals something about the actual value of the moves played.

Note. Definitions are from (Nam, 2004) or (Richard Bozulich, 2001) unless cited otherwise.

Table 3. Glossary of other terms

Term	Description
Ambiguity	Which of several possible meanings is intended is unclear because the context is unclear. Ambiguity is included in epistemological uncertainty.
Attribute	A proposition consisting of a predicate with only one slot (ref: relation). Used in analogy
Relation	A proposition consisting of a predicate with more than one slot (ref: attribute). Used in analogy.
Filler	The contents of a slot within a proposition. Used in analogy
Ontology	The study of being in general, embracing such issues as the nature of existence and the categorical structure of reality. (Lowe, 2005)
Epistemology	The theory of knowledge; the branch of philosophy concerned with the nature of knowledge, its possibility, scope, and general basis. (Hamlyn, 2005)

Positivist science	A view of science composed of: Ontology: Realism: its most fundamental ontological assumption is that reality exists independently from the knowing subject. It is also deterministic and layered. Reality is composed of discrete entities. The nature of reality can be understood by breaking it down into these constituent parts. There is usually a linear relationship between cause and effect which is independent of the observer. The universe is knowable and predictable. Epistemology: Positivism: Subject and object are separate, as are facts and values. Objective knowledge is possible and its truth can be empirically tested against reality. Universal rules transcend space and time. Knowledge is to be used to manipulate reality to achieve goals. Methodology: Deductive and analytical: reality can be broken down into its constituent parts are analyzed. Standards can be established. (Morçöl, 2001)

Complexity science	This perspective is not yet agreed upon. However, the source considers these aspects: Ontology: Realist in general (there is an independent reality), but our knowledge of reality is contextual. Reality is both deterministic and indeterministic: there are emergent systems irreducible to their parts, systems co-exist and co-evolve. Reality is mostly nonlinear, and not predictable. Systems are always in transition. There is order in chaos, or in other words, order and chaos coexist, and order (in the form of a complex adaptive system) can emerge (self-organize) from chaos (its surroundings) using simplicity (simple rules). Species live in the niches afforded by other species. Epistemology: Postpositivism: Subject and object are not separate, the observer is part of the observed reality: the observer defines the systems to be observed. Time is irreversible and the future therefore unpredictable, but there are "islands of determinism", i.e. there are discoverable rules, but they are contextual. Knowledge is to be used to manipulate reality to achieve goals. Methodology: Deductive and analytical as well as inductive modelling and simulations. (Morçöl, 2001)
Gestalt	"a structure, configuration, or pattern of physical, biological, or psychological phenomena so integrated as to constitute a functional unit with properties not derivable by summation of its parts" Gestalt. 2010. In Merriam-Webster Online Dictionary. Retrieved September 9, 2010, from http://www.merriam-webster.com/dictionary/gestalt

Heuristic	involving or serving as an aid to learning, discovery, or problem-solving by experimental and especially trial-and-error methods <heuristic techniques> <a heuristic assumption>; also : of or relating to exploratory problem-solving techniques that utilize self-educating techniques (as the evaluation of feedback) to improve performance Heuristic. 2010. In Merriam-Webster Online Dictionary. Retrieved September 9, 2010, from http://www.merriam-webster.com/dictionary/heuristic

2 Literature Review

My research question is: "What can we learn about project management from the game of Go?" A logical starting place is: "What do we know about the game of Go and about project management?" Answering that question is the purpose of this chapter. The question is broad, so the answer will also be broad – but limited primarily to some aspects related to both project management and the game of Go. I start by looking at the game of Go: its characteristics, the characteristics of a Go player, and the process of playing a game – with a focus on dealing with change and uncertainty. This is be followed by a section looking at project management in a similar way.

2.1 The Game of Go

2.1.1 Origins of the Game of Go

"By and large, serious academic studies [on the origins of the game of Go] do not exist." (Shotwell, 2001, p. 43). There are only about 200 books about the game of Go in English, most of which are dedicated to teaching various aspects of the game to varying levels of players (American Go Association, 2010). The primary sources about the history of the game in English are the articles in *Go Player's Almanac* (Richard Bozulich, 1992), some articles on the *Go Games on Disk* (GoGoD) database (Fairbairn & Hall, 2010), and a chapter in *GO! More than a Game* (Shotwell, 2003) – which has since been updated on the American Go Association (AGA) website (Shotwell, 2008). Shotwell (2001) addressed many inaccuracies in *A Journey in Search of the Origins of Go* by Shirakawa (1999).

The game of Go is thought to have originated between 3000-4000 years ago in China (Pinckard, 2001c), perhaps as a game, or perhaps as a method of divination by astrologers. It has been used to reflect on the heavens and changes of the seasons, to manipulate the balance of yin and yang in the ever-changing Tao, as a dangerous distraction from one's spiritual duties, a reflection of the greater powers of the universe, as one of the Four Great Accomplishments (along with music, calligraphy and painting), as a mental martial art, or as a way to view business or the wider world (Shotwell, 2003, pp. x-xii).

The oldest existing fragment of a Go board was found in the tomb of Han Jing Di (c. 157-141 BC), and pictured in the October 2001 *National Geographic* magazine (Hessler, 2001, p. 59). However, pottery pieces and pebbles thought to be go stones thousands of years older have been found in China, Siberia and Tibet (Shotwell, 2008).

The earliest known reference to the game is in the *Zuo Zhuan*, the oldest Chinese work of history, completed in 312 B.C. (Shotwell, 2008). The oldest game known to be recorded was played between Lue Fan (Black) and Sun Ce (White) in approximately A.D.196. A record of that game is shown in Figure 1. Because stones do not move, a game record is simple to create by marking the move number on a sheet of lined paper.

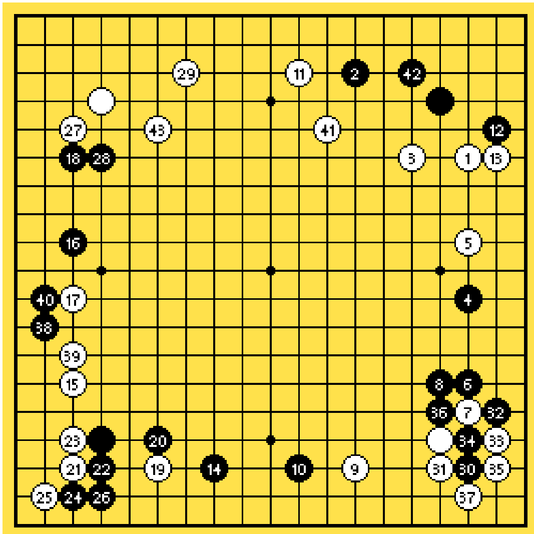

Figure 1. Oldest recorded Go game.

The following quote from Wang Ni, author of *The Classic of Wei Ch'i* written in approximately A.D.1050 and quoted in (Shotwell, 2003, p. 137), combined Confucian, Taoist, and Buddhist thoughts.

> Therefore, the three hundred and sixty intersections of the Wei Ch'i board also have their One. The One is the generative principle of numbers and, considered as a pole, produces the four cardinal points. The three hundred and sixty intersections correspond to the number of days in a year. Divided into four 'corners' like the four seasons, they have ninety intersections each, like the number of days in a season. There are seventy-two intersections on the sides, like the number of (five-day) weeks in a year. The three hundred and sixty pieces are equally divided between black and white, modeled on yin-yang.

The game of Go spread throughout Asia. In the 17th century the level of Go-playing started to advance faster in Japan than in other places because the shogun

Tokugawa established professional go players in government-sponsored Go houses (Honinbo, Inoue, Yasui, and Hayashi), and sponsored official games between the top players of each house in the presence of the shogun (the "castle games"). The competition between the go houses at the castle games led to significant advances in strategy and tactics.

2.1.2 The Game of Go Today

The game of Go is very popular, especially in Asia – with 23 million of the estimated 24 million people worldwide who play the game (Inoue, 2001).

There are several hundred professional Go players in the world, so far all of them trained through one of the professional associations in either Japan (since 1924), in China (since 1961), in Korea (since 1955), and in Taiwan (since 2000). It is even possible to obtain a bachelor or master degree in Go from universities in China or Korea. The game of Go is slowly gaining popularity in the rest of the world (Yang, 2002, pp. 144, 169).

There have been computer programs that play Go since 1970 (Burmeister, 2000), but they have not been very strong until recently. They became much stronger when the Monte Carlo technique was implemented in the MoGo program in 2008, and continue to gain strength quickly. The strongest programs (e.g. DeepZen) are now (November 2011) rated 5 dan on the Kiseido Go Server (KGS) at www.gokgs.com. For an example of the rate of improvement, the current version of ManyFaces of Go, at 1-dan, is 8 stones stronger that the previous version, released in 2002. On a 9x9 board, in 2009 Fuego beat a 9-dan professional in an even game (Wedd, 2010). On smaller boards (e.g. 4x4 and 5x5), the game of Go has been solved – i.e. a computer can calculate the optimum outcome from the first move. Not only is this not yet possible on the larger boards, but the potential number of legal positions is not even known for a 19x19 board. The number of legal positions on a 17x17 board (137 digits long) was only calculated in 2006, taking 8000 CPU-hours. The number of legal positions on a 19x19 board is estimated to consist of 171 digits (Tromp & Farnebäck, 2009).

The game of Go inspired the mathematician John Conway to develop combinatorial game theory, surreal numbers and the concept of thermography (Shotwell, 2003, p. 165).

2.1.3 Description and Rules of the Game of Go

The game of Go is a board game played between two players – one using white lens-shaped pieces called *stones*, the other player using black stones. The board typically has 19 horizontal and 19 vertical lines (see Figure 2). A game begins with an empty board. Black places the first stone – on an intersection of lines, then White places a stone on an empty intersection, then Black plays, and so on, alternating turns. Stones are not moved once played. The objective is to enclose more territory than the opponent. The game ends when both players pass or one player resigns.

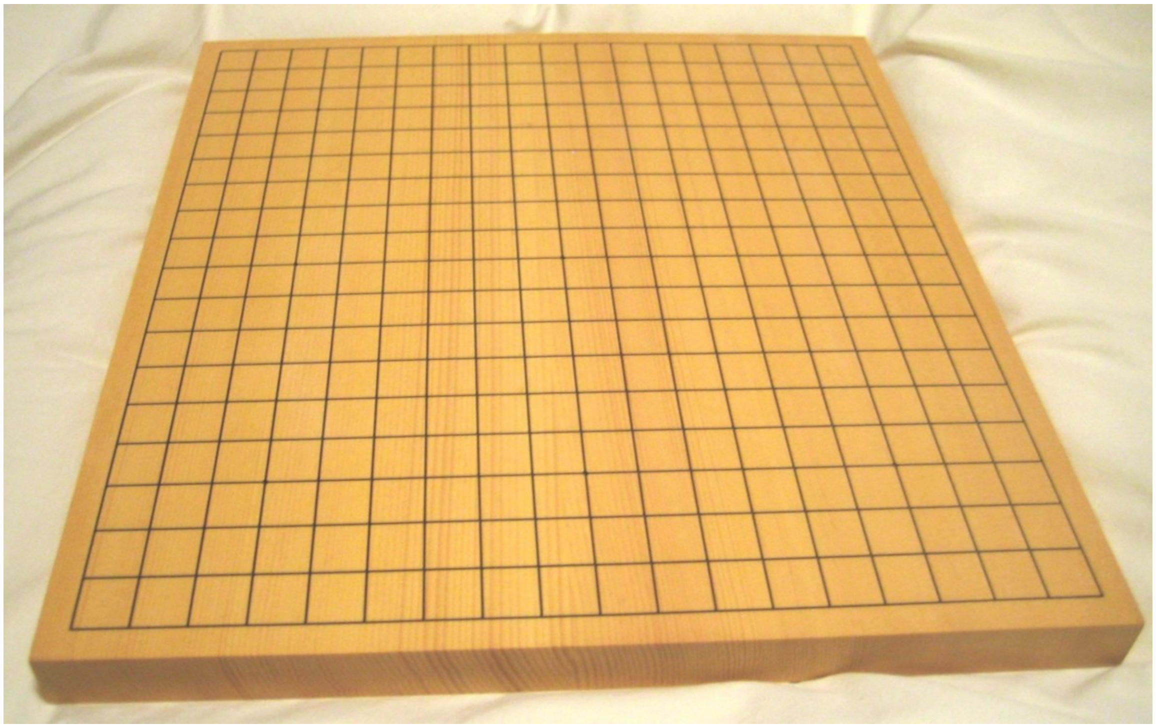

Figure 2. A Go board.

With this basic understanding of the mechanics of the game, there are only two rules of play:

1. A stone or group of stones is removed from the board if they are *captured*. Stones of the same colour connect along lines (not diagonally) to form a *group*. Empty lines adjacent to a group are called *liberties* of that group. Opponent's stones or the edge of the board reduce a group's liberties. When a group's liberties are reduced to zero, the group of stones are captured and removed from the board. Groups that cannot be captured are *alive* (Shotwell, 2006, p. 22).
2. The board position cannot be repeated. This is to prevent an endless game in which each player captures an opponent's stone in a *ko* situation (see diagram). For example, White could play at "a" in Figure 3, capturing a black stone, but

this rule prevents Black from immediately recapturing - because that would recreate the diagrammed board position (Shotwell, 2006, p. 77).

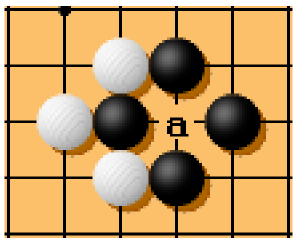

Figure 3. Ko.

There are several different ways to define the rules of the game, so there are several different rulesets. The most significant difference is in the method of counting. The alternatives can have a one or two point difference, which can alter who wins a close game. So clubs usually, and tournaments always, state which rules will be followed. In tournaments there are additional rules such as time limits, player pairings, prizes, etc. (Richard Bozulich, 1992). This research does not require knowledge of the distinctions between rulesets. The basic mechanics and two rules are sufficient.

2.1.4 Characteristics of the Game of Go

"Go … was associated from the beginning with Taoism. Indeed, Go strategies are the same as those that the Taoists applied to life." (Shotwell, 2003, p. 136). The following principles of Taoism are gathered from Fowler (2005). Each is followed by a vertical bar "|" and a sentence or two about how it applies to the game of Go. Where the Taoism principle corresponds with one of the Go principles listed in Table 10 I reference its identifier in parentheses, for example, (G69).

1. *Tao* is the unchanging, unnameable absolute Reality. From *Tao* comes One, the cosmic energy of *qi*, a concentration of powerful creative potential. From *qi* comes the two, *yin* and *yang*. The sophisticated and complex combinations of varying degrees of *yin* and *yang* bring about the whole of the material world and all the ever-changing subtleties contained within it. | A game of Go is an expression of creation (G04) – of *qi* changing from potentiality to reality through the interplay of *yin* and *yang*, of black (*yin*) and white (*yang*), of square (*yin*) board and round (*yang*) stones.
2. All things are equal. | In the game of Go, all the stones are of equal value – none are intrinsically more important than any others.
3. There are recurring patterns (e.g. night & day, life & death, seasons). | In the game of Go, similar patterns occur in game after game. This is also seen in, for example, one player taking the lead for a while but having to give it up to the other player (G69), or in patterns of play in the corners (*joseki*) (e.g. (Y. Ishida, 1977a, 1977b, 1977c)) or in patterns of skillful play in the rest of the board (*tesuji*) (e.g. (Fujisawa, 2004, 2005, 2006, 2007).
4. Balance can be seen at the centre of all opposites. | A Go player tries to balance all the dimensions of the game (e.g. GO'S RULES – G06, G26, G29, G46, G54, G69, G78, G81).
5. *Te* represents the processes of change and transformation in all things – the shifting and dynamic nature of reality. | This dynamism is played out in every game of Go. (G15, G16)
6. Going with the flow of *Te*, and not against it, is the aim of the sage. | The same is true for the Go player. Takemiya Masaki, a former top player in Japan (e.g. 9th

most Japanese titles and 4th most world championships (Power, 2011, pp. 5-6)) advises “playing the moves that you feel are right. If you're too worried about winning and losing you can get too focused on what you think might be the right move and you often lose that way. If you can relax a little bit and have fun with it, very often you'll find you're playing the right moves naturally.” (Garlock, 2008, p. para 3).

7. Minimal action to achieve the goal. Taoism encompasses the idea of *wu-wei* - the art of accomplishing much with the minimum of activity, the ability to act with minimum forced effort … *Wu-wei* is knowing, too, just the right amount to act and when to withdraw. | Go players struggle to achieve this balance – it is the motivation behind Go principles (G45) and (G46), and (G79).
8. The sage is in control of emotions – by appreciating simplicity, realizing one’s true nature and curbing selfishness and desire. With the deeper understanding that real knowledge of *Tao* brings, the ego is transcended, the emotions are controlled, and the self is not swayed by this and that of existence. | The Go player is also admonished to control thinking and emotions (G64, G70).
9. *Qi* can mean the air that we breathe, and the breath itself, it can also be indicative of energy and vitality. | Go players sometimes use the same terms to describe the needs of groups of stones for liberties / eyes / windows / breath to live.
10. *Yin* and *yang* are complementary, not in opposition to each other. They cannot exist without each other, and they contain an element of the other within them. | In the game of Go, White and Black need each other, and some stones even change “owners” during the game – as they are sacrificed or captured, and perhaps recaptured. (G54)

11. Everything is related to everything else. | In the game of Go, each stone or group has an effect on every other group (G10)
12. There are no absolutes. | There are no rules (G81).

A game of Go can be absorbing. In a story by Meng Ch'iao (A.D. 751-814), a woodcutter stopped to watch two people play a game of Go. When the game was over, the handle of his axe had rotted away. (Shotwell, 2003, p. 136). This story is so well-known in China that *ranka* (rotten axe handle) is a literary name for the game of Go (Nam, 2004).

A game of Go is supposed to be friendly. "The 11th century Chinese statesman Wan An-shih captured the gentlemanly spirit of go in this short poem:

> Do not let a pastime upset true affection.
> You can still accord with kind and say, 'I win'.
> The contest over, black and white are collected into two boxes,
> And where is there any trace of loss or gain?" (Pinckard, 2001a, p. 1)

The following is a brief comparison of Chess, Backgammon and Go from Pinckard (2001b, p. 5):

> "Chess, for example, the great historical game of the West, involves monarchs, armies, slaughter, and the eventual destruction of one king by another. … The pieces, from king down to pawn, give a picture of a hierarchical and pyramidal society with powers strictly defined and limited.

Backgammon, the favourite game of the Near and Middle East, is preoccupied with the question of Chance and Fate. All play is governed by the roll of dice over which the player has no control whatever.

Go, the game of ancient China and modern Japan, is unique in that every piece is of equal value and can be played anywhere on the board. The aim is not to destroy but to build territory. Single stones become groups, and groups become organic structures which live or die. A stone's power depends on its location and the moment. Over the entire board there occur transformations of growth and decay, movement and stasis, small defeats and temporary victories.

…in earlier times, when go was so much admired by painters and poets, generals and monks, the point of the game was not so much for one player to overcome another but for both to engage in a kind of cooperative dialogue ('hand conversation', they used to call it) with the aim of overcoming a common enemy. The common enemy was, of course, as it always is, human weaknesses: greed, anger and stupidity.

2.1.5 Go Knowledge

There are several types of Go-related knowledge. The knowledge developed by professional Go players has been documented in thousands of works – most of them in Chinese, Japanese or Korean. There are even bachelor and master-level university degree programs in Baduk (the Korean term for the game of Go) studies in Korea, e.g. Myongji University and Daebul University (Park, 2009). The first European language book on the game of Go, *Das japanisch-chinesische Spiel Go*, by Oscar Korschelt was published in 1880 (Pinckard, 2001c). There are now well over 200 books in English (American Go Association, 2010).

In addition to books, there are magazines, software for playing Go or for studying, and wikis and other websites. Most of the English language Go literature is dedicated to teaching Go to those who want to learn to play or to improve from their current level of play (e.g. instruction, problems, game records). There is quite a bit of material on tournament statistics and status, and about professional Go players (e.g. biographies). Only a little material exists to cover topics such as the history or philosophy of the game of Go – and that is often included as supplementary tidbits to the primary content – for example, (Cho, 1997; Shotwell, 2003; Yang, 2002).

Several attempts have been made to categorize go materials. One categorized Go books in several ways: by publisher, by topic, and by level, e.g. first books, second books, elementary books, intermediate, advanced, and miscellaneous (Go Books, 2008). Carlton (2007) and Sensei's Library (2011) (the Go wiki) categorized more by subject: beginners books, general principles, the opening (fuseki and joseki), middle game (including tesuji, life & death, attack & defense), the endgame, handicap Go, game collections, problems collections, and miscellaneous books. Jasiek (2011) categorized books based on how much each can help a player improve within each category: general concepts, tactics, strategy, specialized concepts, and miscellaneous. The American Go Association (2010) categorized by level (introductory, next steps, and advanced) and by topics (opening, life & death, analysis, tactics, handicap Go, and miscellaneous).

Another source of Go-related knowledge is in the inter-related fields of computer science, game theory, artificial intelligence, and cognitive science as researchers try to develop computer programs that play Go well. There are several very active participants in this field of study, for example, Martin Müller[4], Rémi Coulom[5], David Fotland[6], Sylvain Gelly[7], and Tristan Cazanave[8].

Go theories and principles of play are embedded in many of these sources. But, because most sources deal with specific aspects of the game, or with a particular audience (e.g. beginners), they do not provide a comprehensive set of principles. Anderson, T. (2004) and Yang (2002) both provide a broad set of principles. The two-volume set of Haruyama and Nagahara (1969) and Nagahara (1972) (the latter revised as Bozulich (2007)) includes many key principles.

---

[4] Professor of computer science at the University of Alberta, Canada, author of Go program "Fuego", webdocs.cs.ualberta.ca/~mmueller/

[5] Associate Professor of computer science at the Université Lille 3, France, author of Go program "Crazy Stone", remi.coulom.free.fr

[6] Electrical engineer, author of Go program "Many Faces of Go", www.smart-games.com

[7] Co-author of "MoGo", the first Go program to use Monte Carlo tree search, www.lri.fr/~gelly/

[8] Professor at the University of Paris, Dauphine, Monte Carlo theorist, www.lamsade.dauphine.fr

In addition to the rules there are principles or strategic concepts to help choose where, when, and how to play. These are usually documented in books for beginners and intermediate players, such as Bozulich (1987, 2007), Cho (1997), Guo and Lu (1983), Kageyama (1978), Shen (1996), Shotwell (2006), and Yang (2002). There are also many individual books dedicated to specific techniques – these start at about an intermediate level, for example, Haruyama and Nagahara (1969), and Otake (1992). Many English-language Go books are included in series such as the *Graded Go Problems for Beginners* series (4 volumes), *Learn to Play Go* series (5 volumes), the *Speed Baduk* series (16 volumes), the *Elementary Go Series* (7 volumes), the *Mastering the Basics* series (7 volumes), the *Get Strong at Go* series (10 volumes), and the *Graded Go Problems for Dan Players* series (7 volumes). There are books that continue up to professional level, such as Go (1997), S-R. Kim (2005a, 2005b), and Yoon (2006). T. Anderson (2004) wrote primarily for non-players in an attempt to bring the wisdom of Go to a wider audience.

I chose the set of principles of the game of Go used in this study from a single source: T. Anderson (2004). It covers a broad subset of Go proverbs, yet is concise enough to be manageable. There is no authoritative list of proverbs (at least not in English), nor ways to categorize them. Most, if not all, Go books incorporate some proverbs. There are only four books of Go proverbs available in the English language: Nihon Ki-in (1998) has 151 proverbs, Mitchell (2001) has 22 proverbs, Bradley (2006) has 25 proverbs, and Awaji (2007) has over 100 proverbs. There is one more book that is out of print: Kensaku (1960), which has 43 proverbs, all but two of which are included in Nihon-Ki-in (1998). There is a website, www.gobase.org, on which 192 Go proverbs have been collected. All of these sources of Go proverbs were intended to help Go players to improve their game, and so use detailed proverbs for specific situations or categories of situations. T. Anderson (2004) has combined many detailed proverbs into principles and then into eight top-level rules for the consumption of the public. I have chosen 83 of these principles, which include, for example, 24 of the 192 proverbs on the GoBase website, 24 of the 151 proverbs in the Nihon Kiin book, and only 2 of the 43 in Kensaku's book. Most of the rest of the proverbs are at a detailed level (e.g. "the kosumi is never bad", "don't make empty triangles", "extend after the crosscut", "there is death in the hane", "fill outside liberties first", "don't make only one huge territory", "the monkey jump is worth eight points"). Most of the detailed-level proverbs are not easily translated to other fields, but T. Anderson (T. Anderson, 2004) did the work to help make that easier. See Appendix A for a listing of other sources where the proverbs used in this research can be found (often worded differently, and sometimes implied), written by professional Go players or by professional Go writers. The proverb identifier (e.g. G01) is listed in the first column, the proverb themselves are listed in the second column, followed by a column for each alternate source. The numbers in the cells refer to the page numbers in the source.

Herbert A. Simon (1946, p. 53) pointed out that proverbs almost always occur in mutually contradictory pairs, using the example of "Look before you leap" but "He who hesitates is lost". He went on to claim that "most of the propositions that make up the body of administrative theory today share, unfortunately, this defect of proverbs… Although the two principles of the pair will lead to exactly opposite organizational recommendations, there is nothing in the theory to indicate which is the proper one to apply". He also points out that this problem is not limited to administration. He perceives that the principles "are really only criteria for describing and diagnosing administrative situations". In the same way, we can see the principles of the game of Go and the principles of project management as criteria for describing and diagnosing contextual situations. In this research I focus primarily on the contexts described by uncertainty, change, and conflict. Some secondary situations are also discussed, e.g. definition of project, decision-making, and recommended character traits.

2.1.6 Process of Playing Go

2.1.6.1 Basic Strategies

A player tries to create live groups containing more territory than those of the opponent. The objective of a game of Go is to have more points than the opponent. Points consist of empty intersections completely surrounded by stones of one colour or the edge of the board (i.e. territory), plus points given to the White player to compensate for Black having the first move (*komi*). Captured stones are counted against their own colour (e.g. dead or captured black stones count against the Black player (in some rulesets). Because the opponent can play only one move at a time, a live group must have at least two internal liberties such that the player's group cannot be captured (either two independent liberties (eyes), or two shared liberties, neither of which either player wants to play (because it would kill the player's own group)). Groups with more than six internal liberties are alive because they cannot be killed (if the defender plays correctly).

Because territory decides the outcome of the game, knowing how to judge the size of territory is vital.

A game of Go has a time limit. Informal games are not usually timed, but are typically one to two hours long. Tournament games are timed. There is basic time (e.g. each player has 1 hour), and sometimes there is overtime – which usually has strict limits (e.g. 25 moves within 10 minutes). Consequently a player must manage the use of time. Professional players typically use about ½ of their time on the opening (the first 50 moves or so), and rely on their ability to recall or quickly read out situations that come up in the (more complex) remainder of the game. Lower level players are unable to understand the long-term implications of their initial moves, so do not spend very long on the opening.

Good moves typically make good shape, allowing the player to create territory efficiently. Sometimes it is helpful to understand the opposite. Bad moves:

- Do not make/ add territory
- Do not strengthen weak groups – those that can be easily attacked (i.e. they have cutting points)
- Do not help dead or killable groups make life
- Help the opponent more than the player
- Do not attack the opponent by killing/ threatening to kill, or cut or otherwise weaken opponent's positions.

It is usually best to make moves that perform more than one function/ have more than one purpose.

The game of Go is often described as having three phases: the opening, the middle game or midgame, and the endgame. Strategies specific to each phase are described in the following sections.

2.1.6.2 The Opening – Outlining Potential Territory

Go is a competition between Black and White for space. Players start by occupying the corners (where it is easiest to make territory because the edges act like walls – so two walls are already in place), then extend along the side (because one wall is already in place), and finally jump into the centre. This is traditional advice. But square territories are larger than rectangles (given the same number of stones) implying that jumping into the centre should happen quickly. This is a variation on the proverb: "influence and territory are miai" (G74). Develop as quickly as possible during the opening – don not bother solidifying territory when there are no opponent's stones in the area.

The third line (from the edge) is sometimes called the line of territory, and the fourth line the line of power (the second line is the line of defeat, the first line is the line of death). Playing on the first line is not usually helpful in gaining liberties or life (unless it connects to another group). It is difficult to make life on the second line, so the opponent can usually make a big play because a player needs to make extra moves even to make small territory. It is relatively easy to make life with stones on the third line. It is difficult to make life with stones on the fourth line because the opponent may be able to invade underneath. However, stones on the fourth line can be used to build centre territory, or to influence play in other parts of the board.

The opening of a game of Go is like building a house – a player puts up the framework before filling in the walls. But the opponent may try to tear down a player's walls. A player needs to defend territory by connecting stones, and to attack the opponent's walls and territory by cutting the opponents stones.

2.1.6.3 The Midgame – Fighting

Go favours defence over offence. (e.g. a player adding a stone to a group typically adds two liberties, requiring the opponent to play two more stones to capture them. Therefore, enclosing territory is easier than capturing stones (Yang, 2002).

"Go techniques fall into two groups: enclosing territory and capturing stones. The enclosure of territory involves the concept of comparing *the size of territory*. The capture of stones involves the techniques of fighting between *the strong and the weak*, with the former surviving. The most important thing in fighting technique is to locate *endangered stones* and *cutting points*." Yang (2002, p. 70).

Some capturing techniques are: capture opponent's stones directly; run opponent's stones into your wall or the edge; capture them in a ladder or net (preventing them from gaining life); and split opponent into multiple weak groups and capture the weakest one (i.e. divide and conquer).

Contact fighting (i.e. placing stones in contact with opponent's stones) reduces the number of liberties of the opponent's group. Groups with three or fewer liberties are in danger of being captured directly. To prevent a player's group from being captured, the player will either connect them to other stones to increase liberties, or reduce the liberties of the opponent's surrounding stones, usually by cutting. When the opponent's stones are in contact with a player's group, the player should ensure that the position has no cutting points – playing extra moves if required.

Basic techniques of life and death:

- Making life: ensure at least 6 internal liberties; or make 2 separate eyes; or create seki
- Killing: reduce opponent's group to less than 6 internal liberties; then place a stone on the vital point to prevent the opponent making 2 separate eyes.

The rule that the board position cannot be repeated is to prevent an endless game in which each player captures an opponent's stone in a ko situation (see Figure 3). White could play at "a", capturing a black stone, but Black cannot immediately recapture because that would recreate the diagrammed board position. In order to place a stone there, then Black must play a stone somewhere else first, preferably one to which White will respond, then come back and capture to the left of "a" again. Black's intermediate play is called a ko threat. A ko can be set up intentionally (usually by the person who is behind) to create eye space, to cut the opponent's stones, or to set up an exchange. The winner of a ko fight must play an extra stone (e.g. if Black wins, then Black has to play at "a"). This allows the loser to play two consecutive moves elsewhere on the board – so the ko must be worth the exchange.

There are different ways to connect stones – extension (adding a stone onto a group; slow but no weakness), diagonal (slow, can be cut by immediately adjacent opponent stones); bamboo joint (slow, can be subject to shortage of liberties eventually), jumps – either 1- or 2- space, or knight-shape or large-knight-shape; faster, but easier to cut if opponent stones are nearby).

There are different ways to cut connections: to cut one-space jumps: push through and cut on one side or the other, or wedge a stone between the opponent's stones; to cut a knight's jump: crosscut; to cut a bamboo joint – play at the 4th point before the opponent finishes the bamboo joint; to cut a diagonal: peep or ko; to cut loose connections, e.g. two-space jump: attach and cut; to cut endangered stones: force a shortage of liberties (often by playing inside and/or sacrificing a stone).

Cutting usually leads to fighting, so a player should understand the consequences of making a cut.

When the opponent makes a cut, a player should carefully analyze the situation before responding. What is the key issue? Is it a matter of life & death? Which groups are impacted? What are the neighbouring groups' strengths and weaknesses? Typical recommendations for responding to a cut are: Rescue vital stones (e.g. those that split the opponent into weak groups); make multi-purpose moves; sacrifice something and make a bigger play elsewhere; exchange one group for another group; use sacrificed stones to build thickness or territory on the outside; play flexible moves (e.g. ko); or make eyes to secure life for the cut-off group.

"If a black group and a white group are cut off and surrounded, a life-and-death situation known as a capturing race [or liberty race] arises. The determining factor in the outcome of a capturing race is the liberty count. The side with more liberties lives, and the side with fewer liberties loses." Yang (2002, p. 174).

The purpose of contact battles is mutual strengthening or mutual destruction – supporting whole-board development. Mutual strengthening: because contact fighting usually involves endangered stones and cutting points, both sides make connections and increase liberties, strengthening their weaknesses. Mutual surrounding (settling boundaries of territory) is initiated when a player's territory is bigger than the opponent's. Mutual strengthening (e.g. making/ ensuring life) is initiated when a player's stones are weaker than the opponent's. Mutual destruction: because contact fighting usually involves endangered stones and cutting points, both sides cut and reduce liberties, engaging in destructive exchanges. Mutual destruction is initiated when a player's territory is smaller than the opponent's, or when a player's stones are stronger than the opponent's. "Contact battles are intensive battles at close distance between two sides. Therefore, the side that can first exploit the opponent's weakness or vital point will win. In contact fighting, endangered stones or cutting points are the most important weaknesses and vital points. Therefore, creating endangered stones and cutting points [in the opponent's positions] and exploiting them is the most important technique in contact fighting." "Finally, we must emphasize that the size of [potential] territory is the focus of the opening, but the strength and weakness of stones is the focus of contact fighting. Although the focuses of the two are completely different, the progress of contact fighting should correlate with the direction of the opening. Doing so will avoid unnecessary battles in which losses outweigh gains." Yang (2002, pp. 194-200).

Whether to attack or defend, to capture or sacrifice in contact battles depends on the strength and weakness of the stones involved. With symmetrical shapes, the side that plays first is favoured. Extensions are more powerful than diagonal connections. Stones that are not related to the life and death of a group or its surrounding stones can be given up if necessary – depending on their size. Sacrifice stones that will lead to losses. Sacrifice stones to gain sente, to create outward influence, or to exchange. Often sacrificing two stones is better than sacrificing one. Sacrificing allows a player to make clear-cut, flexible decisions when the opponent is far stronger in contact battles and to avoid being annihilated.

2.1.6.4 The Endgame – Consolidating Territory

"After the deployment of stones during the opening and the contact fighting of the midgame, both players delineate the boundaries of their territories in the endgame." (Yang, 2002, p. 239). Many games are won or lost during the endgame. There are still life-and-death issues, and weaknesses of various types that need to be quantified, prioritized, and played in the correct order. "Therefore, all international superstars in go are experts in the endgame." (Yang, 2002, p. 250).

The game ends either when one player resigns, or both players agree to end the game by both passing. All of the *dame* (open points between black and white groups / external liberties) should be filled in before finishing the game.

Komi is given to White by Black to compensate for Black playing first so that both players have an even chance to win. Komi used to be 4.5 points in the 1940s, was raised to 5.5 points in Japan in 1953, and since 2002 is usually 6.5 points, with some national organizations (e.g. China and USA) now using 7.5 points.

See Appendix E for a record of a top-level professional game.

2.1.7 Deciding Where to Play Next

For each move in the game of Go, a player must decide where to place the next stone. Even though there are many places on the board that the player would like to play, a player is only allowed to place a single stone on each turn. Many factors need to be identified and weighed before making a final decision. This process is typically repeated 100-150 times during a game. Most of the Go proverbs used in this work are actually helpful in making decisions. See Section 5.2 for descriptions of how Go principles are used in making decisions.

Hammond, Keeney, and Raiffa (1999, p. 4) suggested that "an effective decision-making process fulfils these six criteria:

- It focuses on what's important
- It is logical and consistent
- It acknowledges both subjective and objective factors and blends analytical with intuitive thinking
- It requires only as much information and analysis as is necessary to resolve a particular dilemma
- It encourages and guides the gathering of relevant information and informed opinion
- It is straightforward, reliable, easy to use, and flexible."

They go on to recommend a decision-making process (that satisfies these criteria) with eight elements, the first five of which are core to their approach: PROACT (problem, objectives, alternatives, consequences, tradeoffs), uncertainty, risk tolerance, linked decisions. In their book they describe the process in detail – and in so doing describe the process that a Go player uses to decide on a move. The remainder of this section works though that decision-making process used by Go players and documented by Hammond, Keeney, and Raiffa (1999).

2.1.7.1 Problem

Solve the right problem. The correct question for Go players is "Where should I play to maximize the likelihood of achieving the goal (e.g. winning)?" The proverb "Know the goal" (G83) is appropriate here. Most weak players ask different questions, for example: "How should I respond to the opponent's last move?" This goes against the proverb "Don't follow the opponent" (G61).

Answering the correct question first requires having a clear idea of the situation (G19, G20, G49) and the trajectory or directions in which events are moving (G65). As the authors suggest: identify the trigger, the constraints, and the essential elements of the problem. A Go player does a SWOT analysis (identify the **s**trengths and **w**eaknesses of each of the player's and opponent's groups then identify **o**pportunities and **t**hreats for each side) (G03). Try to understand the opponent's intentions (G20).

Defining the problem is relatively easy in the game of Go. The next step gets harder.

2.1.7.2 Objectives

Define the objectives to be achieved to solve the problem – these are the decision criteria. They help define the information required, the justification for the decision, and the importance of the decision. The process is straightforward:

1. Identify all the concerns to be addressed
2. Convert concerns into objectives
3. Separate ends from means to establish the fundamental objectives
4. Clarify what each objective means
5. Test that the objectives capture all interests (i.e. they are complete)

For example, at this point in my Go playing career, my objectives for each move during a game are: to not make a mistake, to look at the whole board and evaluate several alternatives before playing a move, to find the move with the best potential for winning. Note: these objectives apply to every move in a game; there will be specific objectives for each move (e.g. enlarge a moyo, increase territory, oppose the opponent's intentions, etc).

T. Anderson (2004, pp. 16-17) suggested the following categories of objectives for making decisions: consider global and local perspective (G06), consider risk and safety (G26), consider speed of development and stability (G29), plan forward to and backward from the goal (G46), use your resources and your opponent's resources (G54), take the initiative but give it up when you need to (G69), consider expanding and narrowing your perspective (G78), and strive for perfection (G82) while striving to achieve the goal (G32).

2.1.7.3 Alternatives

Alternatives are the potential choices for pursuing the objectives. Better alternatives will likely yield a better decision. As Hammond, Keeney, and Raiffa (1999, p. 45) said, "You can't choose an alternative you haven't considered". At this step the Go proverbs and decision-making recommendations really start to meld.

2.1.7.3.1 Generate alternatives

Hammond et al. (1999, pp. 45-54) suggested:

- "Don't box yourself in with limited alternatives". This is similar to the Go proverbs "Don't follow your opponent" (G61), "Once you see a solution, look again" (G10), and "Expand your perspective" (G14).
- Use your objectives – ask "How can you fulfil the fundamental objectives?" Go players use the proverbs: "Align each move with the goal" (G01), "Each move measurably benefits the goal" (G02), "Each move builds the goal" (G04), "Read, read, read"(G41). This last one incorporates several aspects: practicing reading (detailed planning) improves competence at planning, which improves efficiency, develops heuristics for better play, and helps identify threats and opportunities. A player who can plan in more detail and further ahead can develop alternatives that the opponent may not be able to see or counter.
- Challenge assumed and habitual constraints. Go players analyze moves by considering playing sequences in different orders, including backwards from the objective to the current position (G45, G46). This is also part of another process – learning. Japanese have terms for this process: Shu – learn the basics, Ha –

confront your comfort zones, and Ri – develop your own unique approach (G53). This is similar to the progression mentioned in H. Dreyfus and Dreyfus (2005): novice, advanced beginner, competence, proficiency, expertise.

- Set high aspirations. "Strive for perfection" (G82), "Don's play lukewarm moves" (G09).
- Do your own thinking first. This is like "Take the initiative" (G61), and "Read, read, read" G41),
- Learn from experience – this is the same as for Go players (G43), plus "Learn from your opponent" (G57)
- Ask others for suggestions. During a game Go players cannot ask for help, but when analyzing the game afterward, they can ask their teacher or other players for suggestions (G58). A Go player can try, though, to put himself in the opponent's position ("See through your opponent's eyes" (G51), although "your own plans are hard to see, the opponent's even harder" (G65). Because both a player and the opponent are looking for the biggest move on the board, often "the opponent's best move is your best move" (G55)
- Never stop looking for alternatives – similar to one already mentioned: "Once you see a solution, look again" (G10), and also "take advantage of opportunities" (G17), or "Plan to discard the plan" (G16).

2.1.7.3.2 Tailor your alternatives to your problem

Hammond et al. (1999, pp. 54-58) identify four categories of alternatives: process, win-win, information-gathering, and time-buying. The process alternative includes the selectionism and the iterate-and-learn methods of addressing uncertainty (more on this a little later). In the win-win category, Go players do not usually expect to kill opponent groups, but do hope that they get a bigger share than the opponent, e.g. "attack to gain a small profit, not to kill" (G48). Go players use probes to gather information (G67). In the time-buying category are the following proverbs: "make flexible moves" (G14), "timing is everything" (G36), and "Don't resolve uncertainty before its time" (G76).

2.1.7.3.3 Know when to quit looking

Eventually, one has to say "enough is enough" when looking for alternatives. But when? Hammond et al. (1999, pp. 58-59) recommend stopping when "yes" is the answer to all of the following questions:

- Has the player thought hard about the alternatives?
- Would the player be satisfied with one of these alternatives?
- Does the player have a range of alternatives? Are some distinctly different?
- Do other elements of the decision (e.g. consequences, tradeoffs) require the player's time?
- Would time spent on other decisions or activities be more productive?

2.1.7.4 Consequences

Identify how well each alternative meets the objectives. "*Be sure you really understand the consequences of your alternatives before you make a choice. If you don't, you surely will afterwards*" (Hammond et al., 1999, p. 63). The Go proverb associated with the second part of this advice is: "To ingrain a rule you often have to fail" (G08). The better you understand the consequences, the better the decision you are likely to make. This is equivalent to “Read, read, read” (G41).

The authors recommend starting by describing consequences with appropriate accuracy, completeness, and precision. The Go proverb “See the interconnections” (G10) speaks to this. It suggests considering the impact of a move on the current situation and also on potential future situations.

Continue by building a consequences table (Go players usually have to do this in their head).

> Step 1: Mentally put oneself into the future. Go players use these proverbs for this step: “Read, read, read” (G41), “see the interconnections (G10), and “Analyze activities backward from the objective” (G46).
>
> Step 2: Create a free-form description of the consequences of each alternative. Go players do not perform this step.
>
> Step 3: Eliminate any clearly inferior alternatives.
>
> Step 4: Organize descriptions of remaining alternatives into a consequences table, and compare the alternatives. The consequences table consists of listing the objectives and sub-objectives along the left side, the alternatives along the top, and describing how each alternative addresses each objective in the corresponding cells. Use common scales where possible. Here is a template for the consequences table:

Table 4. Consequences table

	Alternative 1	Alternative 2	Alternative 3
Objective 1			
Objective 2			
Objective 3			

2.1.7.5 Tradeoffs

Rarely does one alternative satisfy all objectives better than all the other alternatives. Usually one alternative better meets one objective, while a different alternative better meets a different alternative. A decision-maker has to trade costs and benefits of some alternatives for the costs and benefits of the alternative that provides the highest value. "Clarity of goal is essential for knowing what to sacrifice" (G60). "*Decisions with multiple objectives cannot be resolved by focusing on any one objective.*" (Hammond et al., 1999, p. 80). Even though the single determinant for winning a game of Go is the relative amount of territory between the two players, a focus on territory alone will not likely win a game.

First, rule out alternatives that are dominated by another alternative, i.e. "if alternative A is better than alternative B on some objectives and no worse than B on all other objectives" (Hammond et al., 1999, p. 81). Alternative B can also be eliminated if it is only slightly better than alternative A in less important ways. If there are still a number of alternatives, build a second consequences table using rankings of alternatives by objective. i.e. for each objective, rank each alternative with 1 being the more preferred (ties are allowed). This may make it easier to see if there are dominated alternatives.

If there are still a number of alternatives remaining, then use the even swap method (Hammond et al., 1999, pp. 84-99). This method allows the decision-maker to reduce the number of objectives that need to be considered in making the decision. Do this by increasing the value of an alternative for one objective while decreasing its value for another alternative – swapping. After doing this, review the table again looking for dominated alternatives. This is an iterative process, ending when a decision is reached. This is essentially what T. Anderson (2004) proposed when he suggested to Balance global and local (G06), Balance owe and save (G26), Balance loose and tight (G29), Balance reverse and forward (G46), Balance player and opponent (G54), Balance leading and following (G69), Balance expansion and focus (G78), Balance perfection (G82) with achieving the goal (G32). The result of all this work is the principle "Play to the biggest area" (G28).

2.1.7.6 Uncertainty

Often a person does not have all the information needed to make a completely rational decision. Often the consequences of an action are unknown or uncertain. Hammond et al. (1999, pp. 105-130) only include qualitative risk analysis methods appropriate for instructionism, e.g. probability-impact matrix and decision trees, similar to those included in the PMBOK® Guide (Project Management Institute, 2008a), and do not discuss selectionism nor iterate and learn (although the they could be implied under the "process" type of alternative). Go players use all three methods.

2.1.7.7 Risk Attitude

People and organizations have different attitudes to risk-taking – from risk-averse, to risk-neutral, to risk-seeking. Note that the term *risk-neutral* for Hammond et al. (1999, pp. 150-151) is equivalent to Hillson's (2009, pp. 54-57) *risk-tolerant*, and Hillson (2009, p. 57) defines risk-neutral differently: "an impartial risk attitude with a preference for future payoffs. … [they] seek strategies and tactics that have high future payoffs. They think abstractly and creatively and envisage the possibilities. They enjoy ideas and are not afraid of change or the unknown. For both threats and opportunities they focus on the longer term and only take action when it is likely to lead to significant benefit." This can be seen in Go players – some like to build moyos (Takamiya Masaki is the usual example), which have a high-risk : high-reward potential (G74), but most players prefer a territory-oriented, "safer" way to play (G39). Professional Go players are risk-neutral, but Takamiya would be further toward the risk-seeking side of the spectrum. I would go so far as to say that the game of Go instills a risk-neutral attitude in Go players – they must accept and manage risk in order to win games, e.g. "Adjust risk according to the score" (G22), and "You have to risk to gain" (G23). See Hillson (2009) for more on managing risk in projects.

2.1.7.8 Linked Decisions

Linked decisions are those that "involve a necessary connection between the current decision and one or more later ones." (Hammond et al., 1999, p. 159). The alternative selected today creates the alternatives available tomorrow and affects the relative desirability of those future alternatives. The current alternative may open or foreclose alternatives in the future. The typical decision-making pattern is a string of decide, then learn, decide, then learn more, decide, then learn and so on. This is the iterate-and-learn method of Loch et al. (2006). The process, according to Hammond, et al. (1999, pp. 164-169), is this:

> Step 1: Understand the basic decision problem (problem, objectives, alternatives), then select the uncertainties that most influence consequences. The uncertainties are the crux of linked decisions. Without them, there would be no reason to link decisions in decide-learn sequences, because there would be nothing to learn between decisions. Narrow down the list of uncertainties to the small number that significantly influence consequences.
>
> Step 2: Identify ways to reduce critical uncertainties – what kind of information would help make a decision, and how can it be obtained? For the Go player, a relevant proverb is "Play a probe" (G67).
>
> Step 3: Identify future decisions linked to the basic decision. This is based on the situation and trajectory analysis done when gaining an understanding of the problem. The further ahead a Go player can read, the more the player can understand the potential future questions embedded in whichever basic decision

is made (G41, G42). For beginners, though, there are too many alternatives, and they make too many mistakes in reading, so it is better for them to just "try something" and learn the implications (G43). This is similar to the selectionism strategy for dealing with uncertainty (Loch et al., 2006).

Step 4: Understand the relationships in linked decisions. This is the same as "See the interconnections" (G10). This follows from gaining an understanding of the situation (G03, G19, G20, G41, G49, G65). In the game of Go, every stone has an influence on the rest of the board, so a fresh analysis of the situation needs to be performed every move. The authors describe the process for creating a decision tree – this is essentially the process of reading that Go players use "read read, read" (G41):

- Get the timing right (e.g. what are the dependencies? When will key information become available?); Go players use tewari analysis (G45) – analyzing moves in different orders to find the best way forward by identifying mistakes or inefficiencies in alternate sequences.
- Sketch the essence of the decision problem (e.g. build the decision tree/ dependency diagram),
- Describe the consequences at the end points (for Go players – read through sequences until the situation is stable for both players). Every Go proverb suggests consequences to watch for – that's why they were created.

Working through this step will likely lead to pruning some of the branches from the decision tree.

Step 5: Decide what to do in the basic decision. If there is information that needs to be collected for any alternatives, calculate the cost:benefit of doing so – that may eliminate some remaining alternatives. Do not collect the information if it doesn't provide sufficient benefit – "Don't resolve uncertainty before its time" (G76). With the remaining alternatives, work through the tradeoffs and risk attitude higher-level steps to reach the basic decision.

Step 6: Treat later decisions as new decision problems. After making and implementing the basic decision, there is a good chance that the situation has changed from what it was predicted to look like. Treat the next decision as a new problem. "Don't get attached to your first plans" (G13), "Change plans when the context changes" (G16), "The key to planning is the planning, not the plan " (G77).

Hammond et al. (1999) recognized that the plans you make need to be flexible in fast-developing situations. They suggest four alternatives for dealing with this uncertainty, and they match exactly with the recommendations made by Loch et al. (2006):

- All-weather plans are like using simulation and project buffers (Loch et al., 2006), which is like Go players using traditional Go proverbs – a few of the most common being: "corner side centre" (G28), "urgent before big" (G25), "make good shape" (G35), "take sente" (G61), "have a good next" (G66), "Play moves with multiple meanings" (G73). They are almost always good advice, but often not the best advice.

- Short-cycle plans are the same as Loch et al. (2006)'s iterate-and-learn. This is standard play for Go players, but a relevant proverb is "Change plans when the context changes" (G16).
- Option wideners are equivalent to Loch et al. (2006)'s selectionism, and similar to the Go proverb "Play light moves" (G14).
- "Be prepared" plans are equivalent to Loch et al. (2006)'s contingency plans. Similar Go proverbs are: "Leave aji before leaving" (G80), and "Plan your exit strategy" (G79).

Other writers on decision-making have developed similar analyses and recommendations. See, for example, Snowden and Boone (2007) and Courtney, Kirkland and Viguerie (1997).

Hammond et al. (1999) end this section with the advice to maintain perspective. This is similar to the Go proverbs "Be objective" (G64), "maintain self control" (G70), and "brutal honesty wins more games than hope" (G19).

2.1.7.9 Psychological Traps

The previous sections have dealt with the process of decision-making. However, there is a category of errors, called "psychological traps" that can ruin this process. These are due to our minds using heuristics and biases to make decisions without conscious effort – a life-preserving skill when hunting or being hunted, but less useful when trying to make rational decisions (Hammond et al., 1999; B. Richardson, 2009). Many Go proverbs are intended to combat these errors.

- The anchoring trap: giving disproportionate weight to initial impressions / overrelying on first thoughts. Some Go proverbs to address this problem are: "Don't follow your opponent" (G61); "Analyze moves in different sequences (G45); "be objective" (G64); "self control" (G70), "Balance global and local perspectives" (G06), "Balance risk and safety" (G26), "Balance fast development and stability" (G29), "Balance planning backward and forward" (G46), "Balance the use of player's and opponent's resources" (G54), "Balance leading and following" (G69), "Balance expansion and focus" (G78).
- The status quo trap: continuing to do what has been done in the past. Go proverbs to address this problem are: "Plan to discard the plan" (G16) and "SHU HA RI" (G53).
- The sunk cost trap: including unrecoverable past investments into current decision criteria. Some related Go proverbs are: "Take your medicine" (G07), "Stones become fixtures" (G18), "Don't throw good stones after bad" (G37), "Give up superfluous stones" (G38), "Don't be attached to your stones" (G59).
- The confirming-evidence trap: looking for information that supports our biases, and ignoring contradicting information. Yuan Zhou (2009a) calls this "wishful thinking".
- The framing trap: asking the wrong question. Related Go proverbs are: "Know your goal" (G83), "Be objective" (G64), "Do a SWOT analysis" (G03), "Clarity of goal is essential for knowing what to sacrifice" (G60), and the Balance proverbs:

"Balance global and local perspectives" (G06), "Balance risk and safety" (G26), "Balance fast development and stability" (G30), "Balance planning backward and forward" (G46), "Balance the use of player's and opponent's resources" (G54), "Balance leading and following" (G69), "Balance expansion and focus" (G78).

- The overconfidence trap: we usually do not expand our thinking enough – we create false constraints. To deal with this problem are these proverbs: "Don't be happy when ahead, don't be distraught when behind" (G64), "If you lead be careful, if you follow be careful" (G68), "maintain self-control" (G69), "Once you see a solution, look again" (G10).
- The recallability trap: being unduly influenced by dramatic events. To overcome this problem: "Be objective" (G64), "maintain self-control" (G69), "do a SWOT analysis" (G03).
- The base-rate trap: neglecting relevant information. The reason for so many of the Go proverbs is to remind Go players to pay attention to all the relevant information available to them. E.g. "do a SWOT analysis" (G03).
- The prudence trap: being over-cautious. To address this problem, remember "brutal honesty wins more games than hope" (G19), "Be objective" (G64), "maintain self-control" (G69), "do a SWOT analysis" (G03). These same Go proverbs address the next several psychological traps.
- The outguessing randomness trap: seeing patterns where none exist (or the opponent intentionally misleads a player – the ancient Chinese military text "The 36 Strategems" is a collection of treacherous plots, and Go players use them all (Ma, 2000). "Brutal honesty wins more games than hope" (G19), "Be objective" (G64), "Maintain self-control" (G69), "Do a SWOT analysis" (G03).

- The surprised-by-surprises trap: Accept that there are many unpredictable events that happen in our lives, and remember these proverbs: "brutal honesty wins more games than hope" (G19), "Be objective" (G64), "maintain self-control" (G69), "do a SWOT analysis" (G03).

2.1.7.10 The Wise Decision Maker

Hammond et al. (1999) provide a few final recommendations, some of which were covered earlier; a few more have similar Go proverbs. Zoom in and zoom out (i.e. looking at both the high-level decisions as well as tactical- or operational-level decisions). As they say, "you don't make decisions at any level until you've considered decisions at each level several times. … Considering the impact on lower-level decisions serves as a reality check on the higher-level one before you make it." (p.221). This is exactly the meaning behind "Change between global and local perspectives" (G05).

Finally, Hammond et al. (1999) ask "Who should make your decisions? You should." (p.228). You are responsible for choosing and making decisions. The decision-making process is an aid, but cannot make the decisions for you. Similarly, a Go player is responsible for playing the game, and deciding where to place each stone, and "Don't rely on simple proverbs" (G81).

2.1.8 Characteristics of Go Players

A Go Sage is far-sighted, calculates accurately, and remains in charge of the entire game (Yang, 2002, p. 84).

In some countries, the game of Go is considered to be a mental martial art (Shotwell, 2003, p. 33). It was considered one of the Four Great Accomplishments of China and Japan. Currently it is included in the World Mind Sport Games (http://www.imsaworld.com).

"Some professional Go players talk of feeling 'actual pressure' when their groups are leaned on – that they see a way out of their enemy's surrounding stones as if they are physically crawling out of a trap." (Shotwell, 2003, p. 163)

"Professional players comment that what is generally wrong with amateurs is that they are too aggressive – they are not thinking deep enough to discover the superior strategies." (Shotwell, 2003, p. 166).

Potter (2001, p. 12) observed that "one often sees these three characters [禮, 智, and 仁] written with broad, heavy brush strokes on silk scrolls hanging in go clubs throughout China and Japan. They are taken from the five Confucian virtues: *li* [禮] (propriety), *chih* [智] (wisdom), *jen* [仁] (human-heartedness), *i* 義 (righteousness), and *hsin* 信 (sincerity)." Following is a brief description of each of these three virtues, also from Potter (2001, pp. 13-14):

> The *Li Chi* [*Records of Propriety* – one of the ancient Chinese classics] begins: 'Always in everything let there be reverence; with deportment grave as when one is thinking [deeply], and with speech composed and definite.' … Propriety distinguishes men from brutes. … Without genuine warmth, kindness and

> consideration for the feelings of others, propriety loses its spirit…. *chih* (wisdom) refers to knowledge as well as to wisdom, and has a moral aspect…. Wisdom is the innate knowledge of what is right and wrong…. *jen* (human-heartedness) … represents man and his moral relation to others. … Compassion, goodwill, humanity, kindness, mercy are all close…. Of the three – propriety, intelligence, and kindness – it is 'propriety' that has been held in the greatest veneration. Perhaps more than anything else, this explains the spirit of dignity and consideration that guides participants in what is a competitive game.

Each player has their own style. For example, Kato Masao & Seo Bong Soo prefer fighting (Zhou, 2009b); Lee Changho prefers calm and solid (Zhou, 2007); Takemiya prefers to make large frameworks (Zhou, 2008b); Kitani Minoru & Cho Chikun prefer to make territory (Zhou, 2009c); and Go Seigen is fearless in his search for the truth (Zhou, 2008a). "[Lee Changho] will not play risky moves that can lead to defeat. Cho Hunhyun and Yu Changhyok are at the other end of the spectrum. They are brave, making risky moves that lead to dynamic variations." (Yang, 2002, p. 209).

The game of Go can be absorbing, as this old Japanese poem implies:

Saying 'just one game'	Tatta hito-ban to	
They began to play …	uchihajimeta wa	
That was yesterday.	sakujitsu nari	(Pinckard, 2001d, p. 27)

Yang (2002, p. 188) provided this advice to Go players who want to get stronger: "one must understand the theory of Go, practice, and study professional games." He went on to add the "techniques of getting strong:

1. Repeated consideration of the pros and cons of the opponent's position.
2. Comparing outcomes of variations.
3. Eliminating bad moves
4. Considering moves other than the traditional ones.
5. Considering various sequences."

2.1.9 Analogy with Project Management

Only a cursory understanding of the game of Go will provide the necessary background to recognize surface similarities between the game of Go and project management. These are categorized according to the three research questions: the nature of projects (Table 5), characteristics of project managers (

Table 6), and ways of managing projects (Table 7).

Table 5. Surface similarities between the game of Go and projects

Characteristic	Go	Project
Has a beginning, a middle, and an end. The beginning is characterized by a lack of information and uncertain quality of information, the middle is characterized by complexity, and	√	√

the end is characterized by determinism.		
The requirements are often not clear at the beginning	√	√
Unique	√	√
Time and resource constrained	√	√
Goal is to produce deliverables	√	√
Risky , i.e. there is a significant chance of not achieving the goal	√	√

Table 6 Surface similarities between Go players and project managers

Characteristic	Go Player	Project Manager
Has responsibility for achieving the goal	√	√
Has to overcome many obstacles to achieve the goal	√	√
Has to know the status at all times	√	√
Is constantly evaluating the local and higher-level context (i.e. strategic and tactical)	√	√
There is a ranking system / career path	√ - 25-1 kyu, 1-7 dan, 1-9 dan pro	√ - associate, certified, senior

Table 7 Surface similarities between playing a game of Go and managing a project

Characteristic	Playing Go	Managing a Project
Influence is vital to success	√	√
Communication between stakeholders is vital to success	√	√

The next chapters provide a methodology for making, evaluating and learning from the analogy between the game of Go and project management.

2.2 Project Management

As with the previous section on the game of Go, this section briefly summarizes the existing literature regarding the characteristics of a project, the characteristics of a project manager, and the process of managing a project – with a focus on dealing with change and uncertainty.

2.2.1 Characteristics of Projects

What is a project? There is a surprisingly wide range of opinion about the answer. Here are some examples:

1. "A project is a temporary endeavour undertaken to create a unique product, service, or result." (Project Management Institute, 2008a, p. 5).
2. "A unique, transient endeavour undertaken to achieve a desired outcome." (Association for Project Management, 2006, p. 150).
3. "A project is a temporary organization to which resources are assigned to do work to bring about beneficial change." (J. R. Turner, 2006c, p. 1).
4. A project transforms inputs to outputs, accepts uncertainty, reduces waste, and maximizes value for the customer, allowing requirements to be changed or further developed throughout the project (Koskela, 2000; Koskela & Howell, 2002b) (paraphrased).
5. "A project is a whole of actions limited in time and space, inserted in, and in interaction with a politico-socio-economic environment, aimed at and tended towards a goal progressively redefined by the dialectic between the thought (the

project plan) and the reality." (Declerck, R., Debourse, J., & Declerck, J. (1997) as cited in (Bredillet, 2004c, p. 5)

6. "A project is a localized energy field comprising a set of thoughts, emotions, and interactions continually expressing themselves in physical form." (DeCarlo, 2004, p. 30).
7. "Complex projects are open, emergent and adaptive systems that are characterised by recursiveness and non-linear feedback loops. Their sensitivity to small differences in initial conditions significantly inhibits detailed long-term planning for these projects, and their implementation is a dynamic process." (Defence Materiel Organisation Australia, 2008, p. 4).

There are many different types of projects, each with different characteristics. Crawford, Hobbs, & Turner (2002) investigated the way projects are categorized in practice. They identified three broad groupings: (a) by size, risk or complexity, (b) by strategic importance, stage of the life cycle or sector, (c) by contract form, payment terms or risk ownership; although each organization uses its own unique categorization method. From a theoretical perspective, several authors have tried to identify ways to categorize projects. For example: Turner & Cochrane (1993) considered the clarity of the project goal and means of achieving the goal to categorize projects; Shenhar & Dvir (2007) identified four dimensions: novelty, technology, complexity, and pace; the Global Alliance for Project Performance Standards (GAPPS) (2007) used seven factors to distinguish between three levels of difficulty of managing a project; Hanisch & Wald (2011) identified three dimensions : the goal of a project, its context, and its design, and several sub-dimensions: strategy, project management, complexity, dynamics, uncertainty, value-added, and adaptability; Bredillet, Turner, and Anbari (2007) identified nine schools of thought, finding a metaphor for each: the project as a machine, as a mirror, as a legal entity, as a social system, as a business objective, as a computer, as an algorithm, as a chameleon, and as a billboard;

In short, there is no consensus on what a project is, what it is for, or what it includes. But, as Morris (2002) points out, the various definitions of project have some points in common: they are temporary, they are intended to make some kind of change, and they go through a life cycle.

All projects have, to some degree, the characteristics mentioned in the introduction (incompletely defined requirements, significant and frequent change, conflict, complexity, and uncertainty). For example, it is impossible to completely specify requirements (Alexander, 1964, p. 102), and if there are several stakeholders, then there will be conflict, change, uncertainty, and likely complexity (Williams, 2002, pp. 49-60). So it is a matter of degree: from projects with goal and methods well-defined and in a stable environment to those in which the goal is loosely defined (perhaps just an idea or concept as in new product development or renewal projects) and the project context is turbulent, ensuring change, conflict, uncertainty and complexity. This research focuses more on projects of the latter type.

2.2.1.1 Concepts of the Target Type of Project

2.2.1.1.1 Context

Projects exist within a context. The context cannot be influenced directly. Characteristics of the context are complexity, dynamics and uncertainty (Hanisch &

Wald, 2011). They point out that “complexity and dynamics lead to higher uncertainty” (p.13).

2.2.1.1.2 Uncertainty

For this research, I refer to uncertainty as it affects projects, that is, solving problems and making decisions. "Uncertainty is the difference between the amount of information required to perform the task and the amount of information already possessed by the organization.” (Galbraith, 1977, pp. 35-36). According to Winch (2004, p. 8), “the management of uncertainty *is* project management”. He also stated that “uncertainty is, by definition, unmeasurable” (p.5). In other words, at the time a decision must be made a decision-maker does not know how much is unknown. Many writers identify two types of uncertainty: epistemic and aleatoric (or ontological or stochastic or variability), for example Williams (2002). A few have gone further to better understand it. For example, Rowe (1994) defined four dimensions of uncertainty: temporal, structural, metrical, and translational. Walker et al. (2003) incorporated Rowe’s analysis in their three dimensions: location (composed of context, model structure, model technical, inputs, parameter and model outcome uncertainties), nature (epistemic and variability uncertainty) and level (from determinism to indeterminacy through statistical uncertainty, scenario uncertainty, recognized ignorance and total ignorance). Tannert, Elvers, and Jandrig (2007) classified ontological and epistemic uncertainty as sub-forms of objective uncertainty, then added moral and rule uncertainty as sub-forms of subjective uncertainty.

It is interesting to note that Williams (2002) discussed uncertainty as a component of complexity, but Rowe (1994) and Tannert, Elvers, and Jandrig (2007) discussed complexity as a component of uncertainty.

2.2.1.1.3 Complexity

Adaptive methods recognize complexity in the complexity science perspective, i.e. it is "a particular dynamic or 'movement' in time that is simultaneously stable and unstable, predictable and unpredictable, known and unknown, certain and uncertain" (Cicmil et al., 2009, p. 29).

Complex projects are complex adaptive systems, i.e. they exhibit nonlinearity, emergence, and states of stability and instability (Cicmil et al., 2009). They deal with highly uncertain goal and methods (DeCarlo, 2004, p. 34). They are opposite to traditional projects on the Goals and Methods matrix (Defence Materiel Organisation Australia, 2008). Adaptive methods are used for projects with partially defined goal and methods (Wysocki, 2009, p. 327).

Rowe (1994) included complexity as part of structural uncertainty; Walker et al. (2003) included structure uncertainty within the location dimension: "Model structure uncertainty arises from a lack of sufficient understanding of the system (past, present, or future) that is the subject of the policy analysis, including the behaviour of the system and the interrelationships among its elements." (p.9).

2.2.1.1.4 Conflict

"Conflicts are a way of life in a project structure" (Kerzner, 2009b, p. 295).

"Conflicts fall into three fundamentally different categories: (1) Groups working on the project may have different goals and expectations; (2) There is considerable uncertainty about who has the authority to make decisions; (3) There are interpersonal conflicts between people who are parties-at-interest in the project." (Meredith & Mantel, 2009, p. 170). They point out that conflict is likely between the project manager, senior management, functional managers, clients, and the project team. In other words, all stakeholders on a project will likely be involved in conflict, and there will always be conflict.

2.2.1.1.5 Change

Change is a part of life (see section 2.1.4, bullet 5). Managing change to a project – e.g. scope, schedule, budget, quality, resources, etc. – is part of managing projects (Project Management Institute, 2008a). However, the rate of change is advancing faster than TPM can manage it, (Dvir & Lechler, 2004; Hillson, 2009). One reason for change is to respond to changes in the context, another is to respond to changes due to complexity of the project, its product, or its interactions with the context; a related reason is to respond to conflict – perhaps from opposition to the project, or changing goals or priorities of the varied stakeholders.

2.2.1.1.6 Decision-making

Decision-making refers to the need to make a choice between two or more options (Herbert A. Simon et al., 1987). Problem-solving adds a phase in front of that which is to first recognize and understand the problem (DeCarlo, 2004, p. 175). Some writers use the terms interchangeably, e.g. (Herbert A. Simon, 1992, p. 163), and so do I.

Winter and Szczepanek (2009, p. 32) point out that people use models or images, typically based on their experience, to make sense of the complex, ambiguous, multifaceted nature of reality. These images inform, as well as limit, their understanding of reality, of problems they face, and of potential solutions.

2.2.2 Positivist Project Management

Project management has been around for thousands of years, using many of the practices currently in use (Kozak-Holland, 2011). But only very recently have theories of project management been documented, for example Andersen (2006), Cicmil and Hodgson (2006), Koskela and Ballard (2006), Koskela and Howell (2002a, 2002b), Laufer (2009), Leybourne (2007), Pollack (2007), Saynisch (2010b), J.R. Turner (2006a, 2006b, 2006c, 2006d), and Wideman (2000). As Bredillet (2004b) and Koskela (2000) point out, prior to this theories did exist, but they were implicit rather than explicitly stated.

The following are different authors' ways of describing traditional projects:

- based on a positivist, realist, deterministic perspective (Bredillet, 2004c; Koskela & Howell, 2002b; J. R. Turner, 2006c).
- "a positivist epistemology, deductive reasoning and quantitative or reductionist techniques, attributes which are often associated with rigour and objectivity. Practice based on the hard paradigm tends to emphasise efficient, expert-led delivery, control against predetermined goals and an interest in underlying structure." (Pollack, 2007, p. 267).

- belief in total rationality and the assumption that the project task is clearly defined and unambiguous (Andersen, 2006, p. 16).
- a functionalist, instrumental view of projects and organisations... This typically assumes rationality, universality, objectivity, and value-free decision-making, and the possibility of generating law-like predictions in knowledge." (Cicmil & Hodgson, 2006, p. 111).
- The project management paradigm "has been described as rational (Lundin & Soderholm, 1995), normative (Melgrati & Damiani, 2002; Packendorff, 1995), positivist (Smyth et al., 2006; Williams, 2004), and reductionist (Koskela & Howell, 2002). … behind the paradigm [of project management] lies a mechanistic world view deriving from Cartesian philosophy, a Newtonian understanding of the nature of reality, and an Enlightenment epistemology whereby the nature of the world we live in will be ultimately comprehensible through empirical research." (Cooke-Davies, Cicmil, Crawford, & Richardson, 2007, pp. 51-52).
- "rational approach and assumes that there is sufficient certainty and stability in the environment that it will be possible to define a set of goals and a framework for orderly planning and delivery of projects" (Jaafari, 2003, p. 55).
- "structured, mechanistic, top-down, system-model-based approaches" (Blomquist, Hallgren, Nilsson, & Soderholm, 2010, p. 6).
- rationalist, normative, positivist, concerned with managing scope (Williams, 2004, p. 3).
- "based mainly on a mechanical, monocausal, nondynamic, linear structure" (Saynisch, 2010a, p. 22).

- “it assumes that the scope of the project is completely knowable in advance; that an appropriate plan can be developed to deliver that scope; and that the problem of control is simply to keep the project delivery to plan. … it presumes that the complete range of possible outcomes can be specified in advance." (Winch, 2004, p. 3).

2.2.2.1 Generic Traditional Project Management Method

In Traditional Project Management, the project management life cycle is traversed once, often with stage-gates between each phase. This life-cycle is taught in many project management textbooks, for example, Cleland and Ireland (2010), Gido and Clements (2006), Kerzner (2009b), Meredith and Mantel (2006), Morris and Pinto (2007), Schelle, Ottmann, and Pfeiffer (2006), and Turner and Simister (2000).

As an example, the following description of the traditional project management life cycle is based on Wysocki (2009), who used four phases: 1) identify a need, 2) develop a proposed solution, 3) perform the project, and 4) terminate the project. The first phase consists of identifying the need, problem or opportunity to be addressed, often documented in a requirements document, or in a request for proposal (RFP) if a significant part of the project work is to be contracted out. The second phase consists of defining the solution to the problem, documented in a project proposal. The third phase implements the proposed solution, being completed when the customer approved that all the agreed work has been completed satisfactorily. The last phase includes all the administrative closing work such as ensuring contracts have been closed, all payments made or received, and reviewing the project for ways to improve in future.

The project proposal created in the second phase is the result of significant planning, including these steps: 1) clearly define the project objective, 2) decompose the scope into pieces that can be estimated and subsequently managed easily, and assign resources to each piece of work, 3) identify the dependencies between tasks to ensure that they would be performed in the correct order and that all required work has been identified, 4) estimate the time required to perform each piece of work, 5) estimate the cost of each piece of work, 6) calculate the total schedule and budget required to perform all of the work to produce the objective by adding up the estimates for all the pieces of work, 7) adjust the plan if required to fit budget and schedule constraints.

Because a project involves uncertainty, there is risk that the project objective will not be met. Usually in TPM, risk is considered "the possibility that an unwanted circumstance will occur that can result in some loss. Risk management involves identifying, assessing and responding to risks to minimize the likelihood and impact of the consequences of adverse events on the achievement of the project objective." (Gido & Clements, 2006, p. 80)

In traditional project management, uncertainty is a threat to the success of the project and is generally considered something to be reduced as quickly as possible so that the rest of the project can be more certain (*cone of uncertainty* or the accuracy of estimates through time is discussed in numerous project management texts, e.g. Gido and Clements (2006, p. 575) wrote of classes of estimates; Kerzner (2009b, pp. 126-127) wrote of stages of budget estimates; Portny et al. (2008, pp. 150-153) wrote of uncertainty and the resulting cost estimate errors over time; and Shtub, Bard, and Globerson (2005, pp. 152-153) referred to the estimation life cycle. There is a nice introduction to the cone of uncertainty in McConnell (2010).

The third phase requires monitoring the progress of the work actually performed against that work defined in the project proposal, and taking corrective action if the actual work deviates from the plan.

Sometimes changes are requested to a project, either by the customer or the project team. The impact of the change on the schedule, budget, resources, quality, etc. needs to be evaluated by the project team and provided to the customer to approve the change. If approved, the project plan should be updated to incorporate the changes.

The fourth phase starts when the product has been completed and turned over to the customer. It includes ensuring that the deliverables were delivered, all payments made, and final evaluations performed. This is the learning phase of the TPM project, where experience gained can be used to improve future projects.

2.2.2.2 TPM Method for Dealing with Target Type of Projects

The traditional perspective of a project is as an essentially closed system (Williams, 2004). TPM "assumes that the scope of the project is completely knowable in advance" (Winch, 2004, p. 3).

Because of the TPM assumptions of determinism and reductionism, TPM perceives complication instead of complexity, and so uses decomposition to break down systems into their component subsystems (e.g. work breakdown structure (WBS) and network diagram) (Williams, 2004).

Traditional project management assumes that conflicts should be and can be resolved, using techniques such as confronting, collaborating, compromising, smoothing, forcing, or avoiding (Kerzner, 2009b, pp. 305-306; Project Management Institute, 2008a, p. 240). Many of these techniques can result in changes to a project.

TPM assumes that the project task is clearly defined and unambiguous (Andersen, 2006), and the complete range of possible outcomes can be specified in advance (Winch, 2004), so any change is assumed to be within the foreseen variance limits. Therefore TPM uses a thermostat-type of control system to keep the project delivery to plan. (Koskela & Howell, 2002b)

There has been little research on decision-making in project management, unlike in general management (Bourgault, Drouin, & Hamel, 2008). Since the time of that article at least one book has been published on the topic, that is, Richardson (2009), although it does not cover some of the issues they identify. The scope of project manager decisions is limited, so a rational decision-making process is satisfactory (Cleland & Ireland, 2010; Deguire, 2006; Wysocki, 2009). Uncertainties not directly related to the planned work on the project are considered outside the scope of the project manager's role, and so are directed toward general management, e.g. "Decision making thus lies at the heart of project governance" (Dinsmore & Cooke-Davies, 2006, p. 183). Decisions in projects are often political in nature and therefore rely on the political savvy of the project manager and other stakeholders (Dinsmore & Cooke-Davies, 2006; Pinto, 1996)

2.2.3 Constructivist Project Management

Pollack (2007) uses the terms *hard* and *soft* for two very different approaches to project management. I use the term traditional project management (TPM) to refer to Pollack's *hard* paradigm.

> The hard paradigm is commonly associated with a positivist epistemology, deductive reasoning and quantitative or reductionist techniques, attributes which are often associated with rigour and objectivity. Practice based on the hard paradigm tends to emphasise efficient, expert-led delivery, control against predetermined goals and an interest in underlying structure. The soft paradigm is commonly associated with an interpretive epistemology, inductive reasoning, and exploratory, qualitative techniques, which emphasise contextual relevance rather than objectivity. Practice based on the soft paradigm emphasises learning, participation, the facilitated exploration of projects, and typically demonstrates an interest in underlying social process. (p.267)

Many other authors have noticed the same different approaches, although not usually using the same terminology: e.g. Andersen (2006), Bredillet (2004c), Cicmil et al. (2009), Jaafari (2003), Laufer (2009), Leybourne (2007), Saynisch (2010a), Shenhar and Dvir (2007), Williams (2004), and Winch (2004), plus many of the Agile authors, e.g. Aguanno (2004), Cockburn (2001), DeCarlo (2004), Highsmith (2004), Schwaber (2004), and Wysocki (2009).

"A variety of books have been written in the agile project management domain which are based on different theoretical foundations … at their core they all are in harmony with the agile principles found in the Agile Manifesto and Declaration of Interdependence." (Fernandez & Fernandez, 2008). These declarations follow:

> We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:
>
> **Individuals and interactions** over processes and tools
> **Working software** over comprehensive documentation
> **Customer collaboration** over contract negotiation
> **Responding to change** over following a plan
>
> That is, while there is value in the items on the right, we value the items on the left more.

Figure 4. Manifesto for Agile Software Development (Agile Manifesto)

(Boehm & Turner, 2004, p. 195).

We increase return on investment by making continuous flow of value our focus.

We deliver reliable results by engaging customers in frequent interactions and shared ownership.

We expect uncertainty and manage for it through iterations, anticipation, and adaptation.

We unleash creativity and innovation by recognizing that individuals are the ultimate source of value, and creating an environment where they can make a difference.

We boost performance through group accountability for results and shared responsibility for team effectiveness.

We improve effectiveness and reliability through situationally specific strategies, processes and practices.

Figure 5. Declaration of Interdependence

(www.pmdoi.org)

Notice that all of these discoveries have been published in the last 10 years – this is a recent phenomenon. As a result, a plethora of new ideas and techniques are being put forth – by the authors mentioned above plus others, e.g. Daniel (2007), Defence Materiel Organisation Australia (2008), and Frame (2002).

2.2.3.1 Adaptive Project Management Method

In this research I use the Adaptive Project Framework (APF) from Wysocki (2009)'s as an example of the constructivist class of techniques (because I am more familiar with it compared to the others), which I refer to generically as adaptive methods.

> [It] consists of a number of phases that are repeated in cycles, with a feedback loop after each cycle is completed. Each cycle proceeds based on an incomplete and limited understanding of the solution. Each cycle learns from the preceding cycles and plans the next cycle in an attempt to converge on an acceptable solution. …the solution has to be discovered. That will happen through a continuous change process from cycle to cycle. That change process is designed to create a convergence to a complete solution. In the absence of that convergence, Adaptive projects are frequently cancelled and restarted in some other promising direction. The success of Adaptive models is leveraged by expecting and accommodating frequent change. Change is the result of learning and discovery by the team and, most importantly, by the client. Because change will have a dramatic impact on the project, only a minimalist approach to planning is employed. Planning is actually done just in time. (pp.404-406)

Wysocki (2009) actually covers a full range of project management methods – from waterfall to extreme. He uses the same terms for the process groups (scope, plan, launch, monitor & control, close) used in each of the five life cycles he describes, simply changing the location of the point to start the next increment/iteration/cycle (the term depends on the life cycle) – see Wysocki (2009, p. 335). The point is that the more uncertainty there is the more that change is expected and incorporated into the methodology.

Controlling adaptive methods requires a fundamentally different approach from traditional project management. TPM assumes that processes are defined in sufficient detail to be repeatable and predictable, and can therefore use defined process controls. Defined process controls will not work in projects with ill-defined goals and methods, so empirical process control is required. This requires visibility (aspects of the process affecting the outcome must be visible to the controllers), inspection (aspects of the process must be inspected frequently enough that unacceptable variances can be detected), and adaptation (the inspector must adjust the process or inputs so that the result will be acceptable). (Schwaber, 2004, pp. 2-3)

2.2.3.2 Adaptive Method for Dealing with Target Type of Projects

Adaptive methods recognize that projects are open systems, they exist and are integrated within a larger context (e.g. part of another organization), their scope and boundaries are not clearly defined (Defence Materiel Organisation Australia, 2008). Adaptive methods recognize that other stakeholders' needs, in addition to the client's needs, must be satisfied.

The uncertainty regarding goals and methods means that, in addition to the variability type of uncertainty recognized in TPM, the goals and methods will have to be discovered or developed, and that, by definition, the scope of the uncertainty is unknown. Discovery and development are incorporated into the Adaptive methods. Loch et al. (2006) identify two approaches for dealing with this type of situation: selectionism and learning. Selectionism means "launching several solution attempts, or sub-projects, each with a different solution strategy to the problem in hand. If the solution strategies are sufficiently different, one would hope that one of them will succeed and lead to a successful outcome. Success depends on generating enough variations so that ex post, we obtain desirable results" (Loch et al., 2006, p. 124). "Learning in projects is the flexible adjustment of the project approach to the changing environment as it occurs; these adjustments are based on new information obtained during the project and on developing new – that is, not previously planned – solutions during the course of the project." (Loch et al., 2006, p. 103). "There are three levels of learning: (1) single loop, (2) double loop, and (3) deutero learning. … There are two types of double-loop learning…: improvisational learning (learning in real time from action variations) and exploratory or experimental learning (stretching from trial-and-error to purposeful experimentation)." (Loch et al., 2006, pp. 112-113).

> The most basic form of experimentation is trial-and-error learning, in which the organization develops and implements its plan but then closely monitors the situation to constantly evaluate whether and how the plan should be modified. The more systematic and exploratory experimentation becomes, the more it contains the *purposeful* search to uncover unk unks, without regard to the success of the trial. The basic building block of experimentation is the Plan-Do-Check-Act (PDCA) cycle, often seen in operations. The key success factor for learning is to keep the PDCA cycle small and fast. (Loch et al., 2006, p. 115)

> Trial and error is a device for courting small dangers in order to avoid or lessen the damage from big ones. Sequential trials by dispersed decision makers reduce the size of that unknown world to bite-sized, and hence manageable, chunks. An advantage of trial and error, therefore, is that it renders visible hitherto

> unforeseen errors. Because it is a discovery process that discloses latent errors so we can learn how to deal with them, trial and error also lowers risk by reducing the scope of unforeseen dangers. Trial and error samples the world of as yet unknown risks; by learning to cope with risks that become evident as the result of small-scale trial and error, we develop skills for dealing with whatever may come our way from the world of unknown risks. (Wildavsky, 1988, p. 37)

Using Rowe's framework (Rowe, 1994), the three methods of addressing uncertainty just mentioned (planning, selection, and learning) can help to address epistemic uncertainty at any location, for levels up to reducible ignorance, and may even help reduce total ignorance. They cannot address irreducible ignorance or uncontrollable inputs. In most cases the methods also help address variability uncertainty. Of course, there is a cost to using each method, so the costs must be weighed against the potential benefit of having the information.

Some adaptive methods were explicitly designed to deal with complexity, e.g. DeCarlo (2004), and Defence Materiel Organisation Australia (2008). However, since complexity impacts change and uncertainty, Adaptive methods really do not address complexity directly (according to the Rowe (1994) framework).

Similar understanding and handling of conflict, compared to TPM, is evident in Adaptive methods (e.g. Wysocki (2009), except that there needs to be even more communication (because of the lack of clarity of goal and methods) on these type of projects (Ambler, 2004). Conflict of ideas, though, is acceptable and even encouraged to develop better options and to prevent groupthink (DeCarlo, 2004, p. 177).

Adaptive methods expect and accommodate frequent change (Wysocki, 2009, p. 405). The work during a cycle is planned in detail, and no changes are implemented during a cycle. All learning and suggestions for future changes to processes and functionality are collected and reviewed, along with all previously-identified items, at the end of each cycle. This allows both process and product to be adjusted every cycle. At the beginning of each new cycle a decision is made on which functionality to plan and execute for that cycle. Because the goal and /or methods are not clear, the project team and client need to explore and learn in order to find a path to an acceptable solution. Adaptive methods are flexible because they focus on providing value to the client incrementally throughout the project so that adjustments to scope, time, resources, budget, etc. can be accepted.

Decision-making in Adaptive methods is fast-paced. Potential performance problems are identified at (short) daily meetings. Changes to the processes being used or to the product being created are possible at the end of each cycle (typically 2-4 weeks long). This level of monitoring and control requires significant time commitment from the client – mostly keeping up-to-date on the product progress and team learning, and helping make decisions. When uncertainty is low rational decision-making tools are appropriate, but when uncertainty is high other tools, including intuition (DeCarlo, 2004, p. 179), and superstition, are appropriate (Deguire, 2006). But, "we have little idea how project managers actually make the decisions that move the project through the life cycle when the deterministic suite of tools can offer little assistance" (Winch, 2004, p. 10). According to Tannert et al. (2007), when there is moral uncertainty (as in conflicting goals and values often found in these types of projects), then decision-makers must use generic moral rules (e.g. the Golden Rule[9]) or intuition. "This means that we act on the basis of fundamental pre-formed moral convictions in addition to experiential and internalized moral models." (Tannert et al., 2007, p. 894). Holyoak and Thagard (1995, p. 147) agree: "Analogies will be especially important when the decision maker is unable to base a decision on simple rules or principles. Such situations arise when the basis for the decision is changing dynamically and when each case is unique in some important way. In domains with these characteristics, analogy is not simply a way for a novice to get started – it is also a basic form of reasoning by domain experts." See Appendix D for two decision-making procedures that use analogy.

2.2.4 Characteristics of a Project Manager

Because there are many types of projects, the choice of project manager should depend on the type of project (Jaafari, 2003; Shenhar & Wideman, 2000; Worsley & Docker, 2000). What kind of person can manage the target type of project?

As there are two major paradigms regarding projects and project management, the same is true for project managers. Rost (1991) identified the industrial leadership paradigm, and the postindustrial leadership paradigm ("an influence relationship among leaders and followers who intend real changes that reflect their mutual purposes" (p.102)). He contrasts leadership against management ("an authority relationship between at least one manager and one subordinate who coordinate their

[9] See Council for a Parliament of the World's Religions.(1993)

activities to produce and sell particular goods and/or services" (p.145)). According to him, industrial leadership

> accepts almost all of the major characteristics of the industrial paradigm: (1) a structural-functionalist view of organizations, (2) a view of management as the preeminent profession, (3) a personalistic focus on the leader, (4) a dominant objective of goal achievement, (5) self-interested and individualistic outlook, (6) a male model of life, (7) a utilitarian and materialistic ethical perspective, and (8) a rational, technocratic, linear, quantitative, and scientific language and methodology. (pp.180-181)

A number of project management authors agree with these two paradigms for project managers, e.g. DeCarlo (2004), and Schwaber (2004).

A number of works align more with the industrial leadership paradigm, e.g. Gareis and Huemann (2000), GAPPS (2007), Project Management Institute (2007); some align more with the postindustrial leadership paradigm, e.g. DeCarlo (2004), Jaafari (2003), Leybourne (2009), Cicmil et al. (2009); and some are in between, e.g. Caupin et al. (2006), Defence Materiel Organisation Australia (2008), and Highsmith (2004). In general, adopters of adaptive methods tend toward the postindustrial leadership paradigm.

2.3 Project Management and the Game of Go

I am not aware of any previous comparisons between the game and Go and project management.

There have been comparisons of project management to principles related to the game of Go. For example, Dr. Low showed how 53 principles from Taoism apply to project leadership (1995). Suen, Cheung, and Mondejar (2007) showed that Taoism (among others) influences ethics in project management. Lang and Zhang (1999) showed that the principles of Taoism can contribute to the understanding of systems thinking. While not directly related, Hawkins and Rajagopal (2005) apply the strategies of the ancient Chinese general Sun Tzu's *The Art of War* to project management.

The game of Go has been used as a source analogy for many aspects of life: war, business, music, daily life. For example:

> This airline business deal can be compared to the game of Go. The total traffic demand between two cities is there to take and divide, just like a vacant Go board. Airplanes, equally efficient and different only in ownership and colour, are alternately put into service on an equal basis, similar to the alternate placement of Go stones. The challenge, as when playing Go, is how to most efficiently and effectively deploy your airplanes. To make a profit, an airline must load one percent more passengers than the number necessary to break even. Because most airlines have a high break-even point, the number of passengers it carries can make the difference between profit and loss. A one percent difference in an airline's load factor can be just as detrimental as one point in a Go game. (Miura, 1995, p. 13)

The next two chapters explain the process and results of using analogy between the game of Go and project management.

3 Research Perspective: The Theory of Analogy

"Of course analogies never prove anything. They only provoke things. They can even provoke thought." (Woodward, 1988, p. 862)

This chapter explores what analogy is, how and why analogies are used, some of their strengths and weaknesses, and describes the method of analogy used in the research. In this thesis I use analogy to provoke thinking about project management a little differently than in the past.

3.1 Analogy Backgrounder

3.1.1 What is Analogy?

First, a couple of dictionary definitions:

1. "a comparison between things which have similar features, often used to help explain a principle or idea"[10]
2. "inference that if two or more things agree with one another in some respects they will probably agree in others"[11]

---

[10] Analogy. 2010. In *Cambridge Advanced Learner's Dictionary*. Retrieved Oct 5, 2010, from http://dictionary.cambridge.org/dictionary/british/analogy

[11] Analogy. 2010. In *Merriam-Webster Online Dictionary*. Retrieved Oct 5, 2010, from http://www.merriam-webster.com/dictionary/analogy

In the academic world, there is no agreed-upon definition or theory of analogy (Kokinov, 1996; Shelley, 2003).

Analogy deals with how we perceive the world. Our perception of the world is an abstract model of the 'real' world (Borella, 2000; Rosch, 1999). Analogy is the way humans think (Hofstadter, 2001); analogy is the way humans learn and do research (Holyoak, Gentner, & Kokinov, 2001); analogy is an almost exclusively human activity (a chimpanzee has been taught to use analogy, but Old World macaque monkeys failed to use analogy after similar training) (Holyoak & Thagard, 1995, pp. 72-73; Ogden, Thompson, & Premack, 2001).

The following few paragraphs are based on the brief history of the development of analogy found in Shelley (2003). He identified three types of theories of analogy: *shared-abstraction* theories of Plato and Aristotle, *shared-attribute* theories of Bacon and Mill, and the *shared-structure* theories developed in the twentieth century.

Analogy from the shared-abstraction perspective refers to an unchanging idea (aka pattern or Form) that is (imperfectly) shared by two or more things. For example, the idea of justice is shared between a city and an individual in Plato's *Republic* (Plato, 1992). Plato and Aristotle base their use of analogy on the formula of proportion, i.e. A : B :: C : D, which is read as "A is to B as C is to D".

Francis Bacon changed the conception of analogy to the sharing of attributes between things compared, without requiring a shared idea. For example, "the four fins of fish and the feet of quadrupeds and the feet and wings of birds are instances of matching." (Bacon, 1620, p. 2:27). Mill added that the number of shared attributes increases the strength of the analogy.

Gentner (1983), building on Bacon and Mill plus more recent works of Keynes (1921), Hesse (1966), Pólya (1957), and Winston (1980), developed the first clearly-stated shared structure theory of analogy, which she referred to as structure-mapping theory (SMT). This theory is used to attempt to understand or comprehend analogies. From this perspective, an analogy is a set of mappings of predicates between a base and a target. The mappings follow three rules:

1. Attributes are largely or completely ignored.
2. Relations are emphasized
3. Systems of relations (aka higher-order relations) are strongly preferred.

Holyoak & Thagard (1995) extend these ideas into their Multiconstraint Theory (MT). For them, an analogy is an alignment of conceptual structures, the strength of which is based on three factors:

1. Structural consistency – each predicate in the source is mapped to a unique predicate in the target, and their arguments are also mapped (according to their roles). This is similar to Gentner's third rule.
2. Semantic similarity – mapped predicates should have the same (or similar) meaning
3. Purpose – the structure built for the target domain should be purposeful, e.g. help to explain a phenomenon or to solve a problem. One aspect of this is the context of the analogy.

> Analogies are not instances of induction as was supposed [prior to shared-structure theories]. Analogies are not based on the establishment of universally generalized rules [as proposed by shared-abstraction theories]. Instead, analogies are based on comparisons between the causal or higher-order relationships in which the items in an analogy participate. (Shelley, 2003, p. 6)

There is one more theory that Shelley (2003) did not include: Hofstadter's high level perception (HLP) theory of analogy (Chalmers, French, & Hofstadter, 1995). This theory is used to attempt to explain how analogies are created in the brain. HLP is used to view analogy as a process from the bottom up; as a representation-building process based on low-level perceptual processes interacting with high-level concepts. The structures of the representations of these situations are, they propose, the product of high-level perception. Analogical thought also provides an illustration of the flexible nature of our perceptual abilities. For instance, making an analogy requires highlighting various aspects of a situation, and the aspects that are highlighted are often not the most obvious features from the beginning. The perception of the situation can change radically, depending on the analogy being made (Morrison & Dietrich, 1995).

Morrison and Dietrich (1995) argue that structure-mapping theory (SMT) and high-level perception (HLP) actually refer to different aspects of the same thing: SMT is a "horizontal" view while HLP is a "vertical" view. For SMT, analogy is the ability to recognise that one thing is like another by mapping one structure onto another according to a similarity comparison based on the relations in the concept structure. For HLP, analogy is a construction built from the interactions between high-level concepts and low-level perceptual processes. The goal of HLP is to explain the processes that make up the construction of representations, and the goal of SMT is to identify the processes common to all or most analogy functions.

A few other concepts that often come up in discussions of analogy (but not used explicitly in this research) are: induction, deduction, abduction, and metaphor. *Induction* is used to generate a rule, based on many observations, that applies to all similar [data] observations. *Deduction* uses rules to understand particular [data] observations. *Abduction* is a two-stage process to find a tentative explanation for some data - consisting of (a) *inferring* a theoretical rule such that (b) the data may be *deduced* from it. "*[M]etaphor* is a subtype of analogy, or 'an analogy with added constraints': all metaphors are analogies, but not all analogies are metaphors" (Itkonen, 2005, pp. 28,41). Metaphors say one thing to mean another: "A metaphor always connects two domains in a way that goes beyond our ordinary category structure. 'Socrates was a man' is literally true, whereas 'Socrates was a lion' is a metaphor." (Holyoak & Thagard, 1995, p. 217).

3.1.2 Why Use Analogy for this Research?

As mentioned in Chapter 1, new theories of project management are needed. Darden and Rada (1988) point out that development of new theories requires concepts not in the data in order to explain the data, and that analogies with other fields are a potential source of those new ideas. Indeed, "theories represent real structure, not literally, but by means of metaphor and analogy" (Hesse, 1988, p. 336). So the reason to use analogy for this research is to bring concepts from the game of Go to project management using a formal, justifiable methodology.

The use of analogy extends back to very early in human language – it was used elegantly in one of the oldest known written works: *The Epic of Gilgamesh* (Holyoak et al., 2001).

Analogy is used in many ways, for example, in law (Ashley, 1988; Hunter, 2004); argument in general (Juthe, 2005); logic, theology and metaphysics (Ashworth, 2004; Borella, 2000; Burrell, 1973); strategy making (Farjoun, 2008; Gavetti, Levinthal, & Rivkin, 2005); qualitative analysis (Aubusson, 2002); software design (Giguette, 2006); in everyday life (Holyoak & Thagard, 1997); for transferring knowledge across different concepts or domains, problem solving and reasoning, mental models for understanding a new domain, creativity, communication and persuasion (Gentner, 1998); and Hofstadter even suggests that the thinking process itself is based on analogy, i.e. not a way of thinking, but the way we think (Hofstadter, 2001). In decision-making, "analogies will be especially important when the decision maker is unable to base a decision on simple rules or principles. Such situations arise when the basis for the decision is changing dynamically and when each case is unique in some important way. In domains with these characteristics, analogy is not simply a way for a novice to get started – it is also a basic form of reasoning by domain experts." (Holyoak & Thagard, 1995, p. 147)

Itkonen (2005) authenticates the usefulness of analogy as a methodological tool of contemporary research, and asserts that analogy is the driving force behind scientific discovery.

Analogy can be used to open our minds to new ideas. "Analogies exist to unmask, capture, or invent connections absent from or upstaged by one's category structures." (M. Turner, 1988, p. 3). This is done by transferring properties from the source discipline to the target (Le Roy, 2001). This transfer is done by finding a common structure that underlies the apparently disparate phenomena. "Transitions from phenomenon A to B means not just 'moving' from A to B but, simultaneously, assuming a structure X which, being common to both A and B, is more abstract than either one of them. Extending the analogy to C often means extending less from B to C than from X to C and also to X'. See Figure 6 (from Itkonen (2005, p. 22)). "X" could be viewed as the shared structure referred to by Gentner.

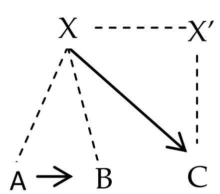

Figure 6. Generalizing from A to B and from B to C

"The search for analogy is identical with the search for ('significant') *generalizations*." (Itkonen, 2005, p. 5). For example, in law, analogical reasoning helps to make the outcome of cases more predictable by giving weight to existing legal decisions and doctrines (Lamond, 2006), i.e. there are structural similarities between cases.

Analogies suggest that there are connections between disparate fields, but analogies cannot be used to prove anything (Burrell, 1973; Connelly, 1996).

Analogies exist within a context. The clearer the context is, the clearer the analogy (Agassi, 1988).

Analogies may be simple, or very involved (Itkonen, 2005, p. 11). Perhaps the most extensive analogy is the one between humour and art proposed by Koestler (1964).

In this research, analogies are intended "to better understand a difficult topic. In some cases, they can lead us to look at a topic or idea in a new way – one which may lead to new insights which prove valuable to our understanding of the topic." (Connelly, 1996, p. para 8). The difficult topic in this research is project management. Looking at project management in a new way, i.e., from the perspective of the game of Go – may lead to new insights.

The use of analogy in project management literature is rare. When it is used, it usually refers to the product of a project, e.g., Kalogerakis, Luthje, and Herstatt (2010), with some articles referring to the use of analogy to assist with estimation or with risk identification. In the literature reviewed, only Jugdev (2004) and Smith (1989) explicitly use analogy with other fields to suggest changes to the practice of project management. Analogies with others fields, such as complexity theory, e.g. DeCarlo (2004) and Dombkins (2007), have been implicitly applied to project management but not explicitly, and therefore not necessarily in a justifiable manner.

3.2 The Multiconstraint Theory (MT) of Analogy Used in this Research

This research uses a variant of the structure-mapping theory of analogy rather than any of the other theories of analogy for the following reasons:

1. Not shared-abstraction because analogies are not limited to two things sharing in one unchanging form (Shelley, 2003, pp. 138-139).
2. Not proportional analogy because it is limited to only four parts, e.g. A:B::C:D, while analogies may be more sophisticated, containing more structure and nuance; the ":" relations need not be identical, and both lower- and higher-level relations cannot be represented in one analogy (Shelley, 2003, pp. 14-15).
3. Not induction because analogies are not based on the establishment of universally generalized rules, but on comparisons between causal or higher-order relationships (Shelley, 2003, p. 6).
4. Not shared-attribute because it ignores the relations and relations among relations, especially causal relations (Shelley, 2003, pp. 145-149).
5. Not high level perception because it helps us to understand analogy more than it helps us learn how to use it, i.e. analogy is not the subject of this study but a tool to be used.
6. Not SMT because it has a restrictive set of constraints (Chalmers et al., 1995, p. 184), and does not incorporate purpose (Holyoak & Thagard, 1995, pp. 258-259). Multi-constraint theory (MT) eases the constraints of SMT, while adding another: purpose. This allows MT to be more easily used, while expanding its usefulness and validity. "In the MT, there is no restriction on the number of items involved in analogical comparisons, nor on the relations among them. In fact, the inclusion of higher-level relations is of central importance to the theory." (Shelley, 2003, p. 15).

Using analogy is a four-step process (Holyoak & Thagard, 1995, p. 15):

1. Select a source analogue (selection)
2. Map the source to the target and thereby generate inferences about the target (mapping)
3. Evaluate and adapt these inferences to take account of unique aspects of the target (evaluation)
4. Learn something more general from the success or failure of the analogy (learning)

Each step is described below.

3.2.1 Selection

Selecting a source analogue for a particular target situation is a complex cognitive challenge. Chalmers et al. (1995) argue that "analogy-making [is] dependent on high-level perception, but the reverse holds true as well: perception is often dependent on analogy-making itself" (p.180) and "the most central and challenging part of analogy-making is the perceptual process" (p.181). Hofstadter refers to this self-referential process as a "strange loop" (Hofstadter, 1979, p. 10). Borella (2000, p. 167) waxes philosophical on this self-referential process. In addition to this fundamental problem, another reason for this challenge is the flexibility of perception of a situation: it may be influenced by beliefs, by goals, by the external context, and it can be reshaped by necessity (Borella, 2000, pp. 171-172).

However, for this research, the method of selecting the source and target analogues is not germane. The point is that the mind is able to identify a relationship between the source and target which satisfies, to some degree, the constraints of structural consistency, semantic similarity, and purpose.

When perceiving using only surface similarities, the analogy may be easy to find, but will not likely be useful unless there are deeper, structural similarities as well (Agassi, 1988). Everything can be a substitute for everything else if the constraints are loose enough. To be useful an analogy must have a context, and the more explicit the context, the "harder" the analogy (Agassi, 1988). The purpose for the analogy must be supported by the analogy (Burrell, 1973; Lamond, 2006; Shelley, 2003). Care must be taken when re-using previous analogies (i.e. that the purpose in using the analogy is still justified), because there is often an anchoring effect due to emotional attachment to the previous analogue (Gavetti & Rivkin, 2005; Shelley, 2003). By the age of six years old, most children have developed the sophisticated capability of using analogy (Goswami, 2001; Holyoak & Thagard, 1995, p. 100).

Doing all of this requires some knowledge of both the source and the target domain – the source domain (Aubusson, 2002) sufficient to understand the reason that the solution in the source domain worked so that the appropriate aspects are transferred to the target (Gavetti & Rivkin, 2005), including how to apply it (Burrell, 1973, p. 250); and the target to understand whether and how to apply the solution to the target.

> The most creative use of analogies depends on both noticing higher-order similarities and being able to map isomorphic systems of relations. These constraints make it possible to map elements that are highly dissimilar, perhaps drawn from very different knowledge domains. We can map elements despite

> the fact that they are dissimilar in many ways, based largely on the constraint of structure. Because the elements to be mapped will have many differences that must be ignored, this kind of use of analogy is difficult. Nonetheless, it provides the possibility of … creative leaps (Holyoak & Thagard, 1995, p. 34).

Shared attributes make the identification of a potential analogy easier, especially for novices, but experts in the target domain will be able to use analogies that have deeper shared structures (Novick, 1988).

"How can a thinker use analogies productively? Of course, we offer no guarantees, but our general answer is: Work with analogies based on system mappings that can be explicitly evaluated with respect to purpose as well as similarity and structure." (Holyoak & Thagard, 1995, p. 36).

"The key [in selecting potential analogs] is to focus on information that is relevant to the goal in using the analogy…. What often matters to an analogy is the set of causal relationships within each analog that bear upon the thinker's goal." (Holyoak & Thagard, 1995, p. 35).

Itkonen (2005, pp. 15-20) developed a taxonomy of types of relations between analogues. He used a two by two matrix based on whether they are ontologically or epistemically symmetric or asymmetric. Type 1 is ontologically and epistemically symmetric, Type 2 is ontologically symmetric, epistemically asymmetric, Type 3 is ontologically and epistemically asymmetric, and Type 4 is ontologically asymmetric and epistemically symmetric.

Using Itkonen's terminology, both the game of Go and project management exist in the same way and are known [approximately] equally well, yielding this relationship as Type 1, which he labels '*discovery*' (in the past). For completeness for the reader, he also labels Type 2 as *discovery*, but in the present or future; Type 3 as *invention* or *creation*; and Type 4 as *copy* or *imitation*.

3.2.2 Mapping

The next step in the analogy-making process has two parts, the first is to map attributes, objects, and relations between the source and the target, and the second is to make inferences based on the mapping. For mapping, I use the semantic structure described in Holyoak and Thagard (1995, pp. 24-37), which is a form of predicate logic. Terms that are used are: *proposition*, *predicate*, *slot*, *filler*, *attribute*, *relation*, *and mapping*.

For each *proposition* (declarative sentence), we use a *predicate* (verb phrase) followed by parentheses enclosing the roles provided by the predicate (called *slots*). The entity that fills the role is referred to as the *filler* of the slot.

Predicate (<slot>, <slot>, ...)

For example, for the proposition "the project is short", we use the following structure:

Short (project)

The predicate is referred to as an *attribute* when a predicate has only one slot. In these cases the verb itself (usually 'is') is often left out. Mapping attributes between propositions is referred to as *attribute mapping*. In the following example we see that a project and game can be compared by their similar attributes: unique maps to unique and game maps to project.

Unique (game)   Unique (project)

Unique ↔ Unique   game ↔ project

Predicates that have more than one slot are referred to as *relations* because there is a relationship between the fillers of the slots. For example, "a project manager overcomes obstacles":

Overcomes (project manager, obstacles)

Each slot in a relation has a particular role in the relationship, so the order of slots and their fillers is important. For example, Overcomes (project manager, obstacles), i.e. a project manager overcomes obstacles, is not the same as Overcomes (obstacles, project manager), i.e. obstacles overcome the project manager.

Mapping the fillers of relations between propositions is called *relational mapping*. These are also known as *first-order* relations. In the following example we see that obstacles and resistance are in some way similar because the relationship is the same between them: Overcomes maps to Overcomes, project manager maps to project manager, and obstacles maps to resistance.

Overcomes (project manager, obstacles)   Overcomes (project manager, resistance)

Overcomes ↔ Overcomes

project manager ↔ project manager

obstacles ↔ resistance

We can proceed to another level: *causal mapping*. If the project manager must overcome the obstacles in order to achieve the goal, we can generate the following propositions:

Overcomes (project manager, obstacles) : overcomes-1

Achieve (project manager, goal) : goal-1

Cause (overcomes-1, goal-1) : cause-1

Predicates that allow propositions to fill their slots are referred to as *higher-order* relations. Higher-order relations are powerful when evaluating analogies (Gentner, 1983; Gentner & Schumacher, 1986).

Mappings should adhere to the following constraints. If they do, the mapping is referred to as an *isomorphism*:

- One-to-one – i.e. every element in the source maps to a unique element in the target, and vice versa
- Structurally consistent – i.e. each slot filler is mapped when mapping relations.

Mappings that use higher-order relations with a high degree of one-to-one mapping and structural consistency are referred to as *system mappings*.

If the constraints are softened a little, in other words, the constraints are no longer mandatory, this is referred to as the *multi-constraint theory* (MT). MT “allows mappings that violate the one-to-one constraint when enough evidence favours multiple mappings” (Holyoak & Thagard, 1995, p. 104).

“Mapping will be much easier if we can weed out as many irrelevancies as possible before trying to map the analogues.” (Holyoak & Thagard, 1995, p. 35).

Making inferences from analogies consists of “copying with substitution” between the source and the target propositions. The more complete the mapping, the more reliable will be any inferences, yet at the same time, the more complete the mapping, the less valuable will be any inferences.

3.2.3 Evaluation

The evaluation step also consists of two parts: evaluation and adaptation. Deciding whether an analogy is “good” or not is the objective of the evaluation part of this step. It is not an objective process. As Darden and Rada (1988) pointed out: “since some properties match and some do not, which of the unknown aspects of the analogue can be fruitfully mapped to the target area?” The “goodness” of an analogy depends on whether it meets the criteria identified above under the S*election* section above and reiterated here:

1. Structural consistency – each predicate in the source is mapped to a unique predicate in the target, and their arguments are also mapped.

2. Semantic similarity – mapped predicates should have the same (or similar) meaning
3. Purpose – the structure built for the target domain should be purposeful, e.g. help to explain a phenomenon or to solve a problem. One aspect of purpose is the context of the analogy.

If a mapping does not exactly conform to the first two conditions, the analogy may still be "good", but it must suit the context and the purpose. The degree of "goodness" is a relative, qualitative measure. The desired level of specificity should be considered a constraint on how well an analogy satisfies its purpose (Shelley, 2003).

This part of the process consists of several sub-steps. First, identify the differences in mapping – they will be either mapped or unmapped. Mapped differences refer to those that map, but not perfectly, between the analogues. From the previous example we infer that obstacles and resistance are similar because the relationship is the same between them: Overcomes maps to Overcomes, project manager maps to project manager, and obstacles maps to resistance. The mapped difference, in this trivial example, indicates that obstacles and resistance are similar because the project manager overcomes each of them. In any analogy there are many elements that are not mapped – e.g. the length of time it took / the number of people helping, the significance of the effort, the benefit of the effort, etc. Inferences based on the unmapped elements have a lower likelihood of being useful for the analogy (Holyoak & Thagard, 1995, p. 132) .

The second sub-step is to identify the consequences of the inference. When possible, test the inference to see whether it is correct. If the inference cannot be tested, then the potential consequences should be more clearly analyzed before acting on the analogy.

The final sub-step when evaluating an analogy is to recommend one of these three possible outcomes:

- the source can be applied to the target;
- it should not be applied to the target, or
- it can be applied to the target with modifications (Aubusson, 2002; Holyoak & Thagard, 1995).

The third outcome is for situations when the analogy seems to apply, but needs to be adapted if it is to be enacted. Sometimes the inference process of "copying with substitution" requires some degree of abstraction. Rather than using specific objects or concepts the substitution may be a process, or another level of abstraction (Holyoak & Thagard, 1995, pp. 133-134). A couple of instances of this adaptation come up in the analogy between the game of Go and project management in the next chapter.

"A single analogy can seldom provide a complete basis for a decision; but aspects of several analogues can often provide part of the basis for developing a coherent plan. Although analogy-based inferences never guarantee optimal decisions, they derive the strongest possible justification when multiple source analogues are mapped to the target at the system level, with the results of these mappings being used as part of an overall evaluation of decision coherence." (Holyoak & Thagard, 1995, p. 146).

"A good analogy is not only understood; it is also felt" – e.g. the thinker feels the excitement and triumph of solving a problem (Holyoak & Thagard, 1995, p. 78).

3.2.4 Learning

Using analogies to understand the underlying structure of situations allows us to apply similar solutions to similarly-structured situations in future. This learning can be built by learning several similar source analogues. Another way is by using an analogy to solve a problem. If successful, a person will try using it again in another situation, learning more about the underlying structure of the situation, and of the potential solutions. Analogy is the way humans learn, and possibly even they way they think.

"If the analogous solution in fact works for both situations, the two analogues can be seen as examples of a common category – a kind of problem that allows a certain kind of solution. The common aspects of the analogues – which may be patterns of higher-order relations – can be abstracted to form a schema representing the new category. The differences between the two analogues, which involve domain-specific details that were not crucial for achieving the analogous solutions, can be deemphasized. The resulting schema will therefore lay bare the structure of the analogues, stripping away the specifics of the individual examples. Once a schema has been learned and stored in a person's semantic network, interrelated with other concepts, it will be relatively easy to access it and apply it to novel problems." (Holyoak & Thagard, 1995, p. 134)

Schemas can be learned not only from multiple initial examples but also by successful use of analogy to solve problems. ... As a result, the person will be yet more successful in transferring the solution procedure to other analogous problems (Holyoak & Thagard, 1995, p. 135).

...any kind of processing that helps people focus on the underlying causal structure of the analogues will improve subsequent transfer to new problems, (Holyoak & Thagard, 1995, p. 135). "Structural correspondences between the source and the target are enhanced by the use of visual representations, which allow the correspondences to actually be seen." (Holyoak & Thagard, 1995, p. 194).

"If the isomorphism is imperfect [between the source and target] – then novice students generally are unable to adapt the analogous solution to take account of the unique requirements of the new problem. Novices will often fail to represent and map crucial higher-order relations that convey *why* a solution is appropriate. They may succeed in transferring a solution by relational mapping yet fail to find the more fundamental system mapping that is based on the causal structure of the analogues. Without guidance from a teacher, analogy is often a trap for the unwary novice, rather than a stepping stone to expertise." (Holyoak & Thagard, 1995, p. 204).

3.3 Limitations and Constraints

Burrell (1973, pp. 10-11) points out a very serious flaw in the use of proportional analogy – it does not work! The problem is with the :: operator. "Since we know how to operate with = but have no idea what to do with ::, the schema a:b::c:d becomes itself an analogy for analogous usage" Consequently we must consider analogy as a model, looking to it more for illustration and understanding than for justification. Similarly, Darden and Rada (1988) state that the existence of an analogical relation cannot itself be tested empirically. “Inferences made by analogy using copying with substitution are never guaranteed to be true. ...analogy is a source of plausible conjectures, not guaranteed conclusions.” (Holyoak & Thagard, 1995, p. 30)

“But [an analogy] might also be highly disruptive to our category structures, and therefore strongly resisted by the conceptual apparatus we already have in place. Therefore, it will not settle into our conventional knowledge readily; it will remain suggestive, but not find a location in our conceptual apparatus” (M. Turner, 1988, p. 6).

Differences between source and target are of two types: mapped (based on a correspondence between non-identical elements) and unmapped. Unmapped differences are more likely to lead to unexpected failures of analogy-based inferences about the target domain (Holyoak & Thagard, 1995, p. 132).

Holyoak and Thagard (1995) point out a couple of other situations in which analogies are difficult to use correctly. One is when similar elements are used in different roles (e.g. they give the example of assigning computers to offices in one problem, and of assigning offices to computers in a second problem). Another is when mapping elements with different underlying concepts (e.g. rates and amounts).

3.4 Conclusion

Analogy is a source of plausible conjectures for dealing with uncertain situations. The ideas that are generated may or may not be viable for the particular context and purpose, but by staying close to the constraints of structure, meaning and purpose, and by using multiple analogies from a variety of sources, the plausibility is increased.

The next chapter will apply analogy between the game of Go and project management.

4 Drawing Analogies and the Key Findings

> The parallels between Go and other fields – business, politics, war, sports, relationships, or life in general – are uncanny…Yet, whether used by an emperor instructing his child how to rule an empire, by Mao planning to take over China, or by CEOs thinking of their businesses, Go has proven to be a worthwhile metaphor. While I cannot make you fluent in Go, I can share rules of thumb that will apply to whatever endeavour you pursue and can demonstrate how these rules' underlying structure can be invoked to give you a leg up on those who just know the rule without knowing the structure. (T. Anderson, 2004, p. 5)

I'm not sure if Anderson knew it, but he used, at least implicitly, the shared-structure theory of analogy in his book. He applied principles from the game of Go to business strategy in general. I intend to apply many of the same principles to project management.

Recall from chapter 3 that analogy is a four-step process consisting of selection, mapping, evaluation, and learning. This chapter follows those steps to describe the analogy between the game of Go and project management. Table 10 (starting on page 154) shows each of the lower-level analogies between the game of Go and project management. Each row contains a Go proverb, stretching across two pages, with the following fields:

- GoID: a code, beginning with the letter "G", to identify each principle

- Proverb: the Go proverb on which the analogy is based. All Go proverbs are taken from T. Anderson (2004). Sometimes the proverb has multiple meanings, so I have broken them into more discrete parts (e.g. "Consider the global context" encompasses many aspects, a couple of which are included here as G01 and G02). See Appendix A for support for the proverbs from other sources. Sometimes the proverb is stated in different ways – when they provide a different perspective they are included. Sometimes the meaning is not obvious, or is ambiguous, in which case I give my interpretation in square brackets, e.g. [ ].
- Go predicates: (the selected source analogue) the translation of my understanding of the proverb into predicate logic
- Mapping: the mapping of predicates and fillers between the source and target
- Inferred PM predicates: (the target analogue) the inference for project management.
- Evaluation: "5" indicates that the analogy can be applied and there is strong support for it in the project management literature, "4" indicates that the analogy can be applied and there is partial support for it in the project management literature, "3" indicates that the analogy can be applied but with no substantial support in the project management literature, "2" indicates that the analogy can be applied with modifications, and "1" indicates that the analogy should not be applied. The modifications are usually mentioned in the Mapping portion of the Comments field.
- Comments: There may be several comments for any particular analogy, each associated with its place in the analogy process: Selection; Mapping and

Inferences (including support for the PM principle); Evaluation including Differences (mapped or unmapped), Consequences, and Adaptation; and Learning. No comment is made when the Go and PM concepts align. Common mapping differences are documented only the first time they appear (e.g. move ↔ activity, player ↔ project-manager, game ↔ project).

In the table PM refers to project management. Principles are primarily worded in a positive way, and negatives are generally not stated. They are left implied, i.e., if one does not follow the principles, the probability of success is reduced.

4.1 Selection

Often surface similarities are initially perceived between two domains, but deeper, structural similarities make the analogy useful. In my case, I was frustrated by trying to manage projects with a high degrees of uncertainty (partly due to loosely-defined goal and requirements), sometimes with significant and frequent change, with conflicting priorities from the major stakeholders, and with many interrelated activities (and projects) - within the constraints of a traditional project management (TPM) perspective and support structure. At conferences and courses I would ask for help with methods for dealing with these problems, but nobody was able to provide any help.

I had been playing the game of Go for a number of years by this time and noticed that some of the situations that occurred in my projects resembled, in a vague way, some of those that occurred during a game of Go. I thought to myself that the game is thousands of years old, has been studied professionally for hundreds of years, and principles have been developed to help deal with these factors, so perhaps those principles could be applied to project management. The surface similarities between the game of Go and project management that I recognized were:

1. A project has a beginning, a middle, and an end – so does a game of Go. The beginning is characterized by a lack of information and uncertain quality of information, the middle is characterized by complexity, and the end is characterized by determinism.
2. The requirements are often not clear at the beginning of a project – they are never clear at the beginning of a game of Go. (G13)
3. Every project is unique – and every game of Go is unique. (G15)
4. A project has time and resource constraints – so does a game of Go.
5. The project goal is to produce deliverables – also in a game of Go (in the form of live groups). (G04)
6. Projects are risky (i.e. there is a significant chance of not achieving the goal) – same with a game of Go. (G16, G23, G26, G68)
7. Project manager has the responsibility for achieving the goal – so does a Go player. G81?)
8. Project manager has to overcome many obstacles to achieve the goal, so does a Go player.
9. Project manager has to know the status of the project at all times – so does a Go player.(G49)

10. Project manager is constantly evaluating the project and the context – so does a Go player. (G03, G19, G20, …)
11. There are different ranks of project manager (e.g. associate, certified, senior) – there is a sophisticated ranking system for Go players.
12. Influence is vital to a successful project – same with a game of Go; although in a game of Go the influence is of groups of stones on other groups of stones. (G74)
13. Communication between stakeholders is vital to a successful project – same with a game of Go; although in a game of Go the influence is between groups of stones. (G56)

Of these, numbers 1, 4, and 8 are not explicitly included in any of the principles listed in Table 10. These three surface similarities will be used for examples in the next several sections.

And there were also deeper, structural similarities and causal relationships such as proverbs for dealing with the high level of uncertainty of the opening (e.g. "corner, side, centre" (G28), and "play away from strength" (G11)), and general guidelines for dealing with the complexity of the midgame such as "look at the whole board" (G01), "urgent before big" (G25), "make good shape" (G35), "to defend, attack" (G47), "don't follow your opponent" (G61), and "build thickness" (G74). There was enough for me to think the analogy was worth pursuing. Using Itkonen's terminology, I "discovered" this analogy.

These are some references to support just the first of the surface similarities listed above:

- A project has a beginning, a middle and an end (Archibald, 2003b), and so does a game of Go (Richard Bozulich, 1987; Shotwell, 2006).
- Project management deals with uncertainty (Atkinson, Crawford, & Ward, 2006; De Meyer, Loch, & Pich, 2002; Project Management Institute, 2008a), and so does the game of Go (Ishigure, 1973; Otake, 1992).
- Project management deals with complexity (Bredillet, 2002; Cicmil et al., 2009; Cooke-Davies et al., 2007; Defence Materiel Organisation Australia, 2008; Frame, 2002; Jaafari, 2003; Macheridis & Nilsson, 2004; Müller, Geraldi, & Turner, 2007; Pich, Loch, & De Meyer, 2002; K. A. Richardson, 2000; Saynisch, 2010a; Sommer & Loch, 2004; Williams, 1999); and so does the game of Go (Bouzy & Cazenave, 1996; Tromp & Farnebäck, 2009). The game of Go is by far the most complex of the perfect-information games on the Olympic List (i.e. those in the Computer Olympiads which are two-player, zero-sum, non-trivial, well-known and require skill. Its state-space complexity has an upper bound of $\approx 10^{172}$, compared to $\approx 10^{50}$ for chess (Allis, 1994). Note that the number for chess has recently been recalculated to be $4.5*10^{46}$ (Tromp, 2010). See http://www.grappa.univ-lille3.fr/icga/event.php?id=41 for the current list of games on the Olympic List.
- Project management deals with determinism (Koskela & Howell, 2002b), and so does the game of Go, e.g., "it is your reading ability more than anything else that determines your rank" (Davies, 1975, p. 5).

These references (and Chapter 2) demonstrate that there is a body of knowledge available about both domains.

The game of Go has been used as a source analogue in a variety of fields, e.g. military (Go, 1942), politics (Boorman, 1969; Kissinger, 2004), business (T. Anderson, 2004; Jeong, 2007; Miura, 1995), and mathematics (Conway, 1976).

A game of Go is a project according to some definitions, e.g. (Project Management Institute, 2008a), but not according to others, e.g. (J. R. Turner, 2006c).

The T. Anderson (2004) book contains the best mix of principles and structure I've found in English. There might be better alternatives in Japanese, Korean or Chinese, but I do not have ready access to those books or their content.

The particular subset of principles from the book that are used in this research were selected because the author believed they were readily applicable to project management. Principles that would not be easily applied to project management were discarded (Holyoak & Thagard, 1995, p. 35). This leaves open the possibility that there may be more principles that could be applied to project management – not only from this book, but also from other sources.

The analogy "project management is like the game of Go" can be understood and analyzed at this high level. It can also be decomposed into the eight "Go's rules" of T. Anderson (2004), each of which can be understood and analyzed on their own, then combined at a higher level. This research goes a level deeper, decomposing the eight rules into 83 analogies, each of which is analyzed on its own, then integrated at higher levels. The simple volume of low-level analogies supports the high-level analogy. This issue is briefly mentioned in Shelley (2003, pp. 27-28).

4.2 Mapping and Generating Inferences

The mapping process is straightforward – identify the predicate(s) to be used and the role of each of its slots, then fill in the slots. Sometimes it can be difficult to decide whether something is an attribute or a slot-filler, e.g. I chose to use player(points) instead of points(player).

To illustrate the mapping step, I walk through an example: the first Go principle in Table 10 "Look at the whole board". In Table 10 this has been decomposed into two propositions: "Each move aligns with the goal" and "Each move measurably benefits the goal". The first proposition could be expanded into the more complete proposition: "A player makes a move such that each move is aligned with the goal in order to improve the probability of achieving the goal". Converting the short form of the first proposition into a predicate yields:

Aligns-with(each-move, goal)

The expanded form of the proposition becomes the following set of predicates:

Makes(player, move) : play

Aligns-with(each-move, goal) : aligns-with

Achieve(player, goal) : achieve

Cause(Cause(play, aligns-with), achieve)

This last predicate is therefore an example of a higher-order relation because it allows propositions as fillers.

To map this analogy to project management, some substitutions are required. Substitute *player* with *project manager* because that is the person making the decisions; substitute *makes* with *defines* because that is the type of decision under consideration; and substitute *move* with *activity* because a move is the smallest manageable unit in a game of Go, and an activity is the smallest manageable unit in a project;

Mapping the relations and the fillers in each of the propositions gives:

game of Go	**maps to**	**project**
Makes	↔	Designs
player	↔	project manager
move	↔	activity
Aligns-with	↔	Aligns-with
each-move	↔	each-activity
goal	↔	goal
Achieves	↔	Achieves
Cause	↔	Cause

Copying with substitution (Holyoak & Thagard, 1995, p. 30) yields the inference "A project manager defines each activity such that it is aligned with the goal in order to improve the probability of achieving the goal". The goal in a game of Go (to gain more points than the opponent) is different from the goal in a project (to create the project deliverables). However, each of these goals could be redefined as "create the highest value for the client" in which case no further substitution or interpretation is needed.

This mapping satisfies the three constraints of the Multiconstraint Theory:

1. Structural consistency – each predicate in the source (i.e. Makes, Aligns-with, Achieve, and Cause) is mapped to a unique predicate in the target, and their arguments are also mapped according to their roles.
2. Semantic similarity – mapped predicates should have the same (or similar) meaning. In this example the predicates are identical, and their meaning is also the same.
3. Purpose – the structure built for the target domain should be purposeful, e.g. help to explain a phenomenon or to solve a problem. In this case it explains the reason that each activity is part of a project- that it supports achieving the project goal.

The mapping above uses higher-order relations with a high degree of one-to-one mapping and structural consistency, and so meets the criteria to be a *system mapping*.

Most of the Go principles (all but G15, G21, G24, G27, G37, G55, G63, G68, G77, and G81) have the same implications mentioned above (i.e., do *proverb* in order to improve the probability of achieving the goal). This research uses the abbreviated form of predicates to avoid massive repetition, and to help make the meaning of each analogy clearer. So, even though

$$\text{Aligns-with(each-move, goal)} \leftrightarrow \text{Aligns-with(each-activity, goal)}$$

looks like a relational mapping between first-order relations, it is actually a system mapping between higher-order relations.

Table 8 lists the most common terms used in the mapping between the game of Go and project management.

Table 8. Terms used in the mapping

Go Term	Refers to	PM Term	Refers to
Goal	the ultimate goal of the game. It consists of many sub-goals called objectives	Goal	The ultimate goal of the project. It consists of many sub-goals called objectives.
Objectives	See Goal	Objectives	See Goal
Move	A move, or series of moves	Activity	An activity or sequence of activities
Position	The status and relationship of a local group of stones with other groups of stones. E.g. a player's position in the lower left of the board is weak. The position should be modified by which player it belongs to (e.g. player or opponent). As an example, in the mapping an opponent's weak position is documented as opponent(weak(position)); Sometimes the "player" or "opponent" attribute may	Position	The status of some work or deliverable, or to an attitude taken on by a stakeholder. Refer also to Situation and Context.

	be discarded if it is obvious or irrelevant in the context. Refer also to Situation and Context.		
Context	The external perspective, rather than local or internal	Context	Same as for Go. For example, a project exists in a particular set of political, economic, socio-cultural, technical, legal and environmental variables.
Situation	The specific position and regional or global context (usually global, but sometimes refer to a subset) at a point in time	Situation	Same as for Go.
Local	The specific groups directly interacting at a point in time. Usually refers to a local (i.e. regional) context.	Local	The specific activities or deliverables directly interacting at a point in time.
Global	The whole-board context – taking everything into account	Global	The whole context of the project, including other projects and organizations – taking into account everything that could affect the project and its outcomes.
Player	Go player	Project manager	Usually refers to the project manager, but possibly also the project sponsor, or project team, or sometimes all positive stakeholders
Opponent	The opposing Go player	Opposition	all forces (active or passive) that interfere with achieving the project goal
Weakness	Anything preventing the player from achieving the goal. Usually refers to a	Weakness	anything the project team lacks to accomplish the goal

	weak position – one not yet fully alive, but could also refer to lack of skill or perception.		
Timing	Includes sequence of moves	Timing	Includes sequence of activities
Intentions	The thinking/ purpose/ motivation behind moves	Intentions	Same as for Go.
Player	Then this mapping is used, it refers to attributes of the game (e.g. the player's position, the player's goal)	Project	The project. In this mapping it refers to attributes of the project (e.g. the project position, the project goal) G32, G34, etc
Play	A Go player plays a game	Manage	A project manager manages a project. G43
Game	A game of Go, as seen from the player's perspective. G27	Project	A project. This is the most common mapping
Play	In this mapping (G57), a player plays a strong opponent	Face	In this mapping (G57), a project manager faces strong opposition
Group-of-stones		Deliverable	G59, G60
(to) Read	A Go player analyzes a position and anticipates the results of moves by playing them out in their head.	(to) Plan	A project manager analyzes a position and anticipates the results of activities by working them out in their head (or with the team). E.g. G41
Move	In this mapping (G50 & G66), a move still refers to a move or series of moves, but especially to the thinking behind it/them.	Plan	In this mapping (G50 & G66), a plan refers to a sequence of activities thought out in advance – usually referring to reaching some interim objective.
Points	Unit of measure to calculate the winner of a game.	Value	Increments of benefit of interest to the client G63, G74

Player	This mapping (G56) refers to players on a team	Member	This mapping (G56) refers to members of a project team
Opponent (points)	This mapping (G22) is only used in this particular context: when calculating the score, the estimated player's points are compared to the estimated opponent's points.	Goal	The goal of the project. In this mapping, the status is calculated comparing the expected value at completion to the goal

Some common relations and attributes were not included in the "mapping" column of Table 10, such as Cause, AND, OR, NOT, When, Else, Has, All, Each, and Greater-than, in order to reduce the length of the mapping and because these words and phrases are common to both sides of the mapping and are easily understood.

Most relations have two slots. The following relations can have more than two slots:

- Choose(<who>, <what>, <attributes or constraints>), e.g. Choose(boy, apple, biggest) meaning the boy chooses the biggest apple.
- Analyze(<who>, <what>, <attributes or constraints>), e.g. Analyze(player, moves, best-sequence) means the player analyzes moves for the best sequence
- Find(<who>, <what>, <attributes or constraints>), e.g. Find(player, moves, best-sequence) meaning the player finds the best sequence of moves.
- Cause(<incident/activity>, <impact1>, <impact2>, …), e.g. Cause(Eats(man, food), gain(man, energy), gain(man, weight)) meaning a man eating food causes the man to gain energy and also to gain weight.

- Consists-of(<what>, <attributes>, <attributes>, …), e.g. Consists-of(desk, top, sides, back, drawers) meaning that a desk consists of a top, sides, a back, and some drawers. Sometimes used to get around the 1:1 mapping constraint (e.g. G19).
- AND(<slot>, <slot>, …), used to combine multiple predicates or attributes or conditions. Sometimes used to get around the 1:1 mapping constraint (e.g. G13).

4.3 Evaluating and Adapting

The Evaluation step consists of several sub-steps: evaluation against the MT constraints of structural consistency, semantic similarity, and purpose; identifying differences; identifying the consequences of the inference; and making a recommendation. All but three of the low-level analogies satisfied the MT constraints. When identifying the consequences of the inference, I looked for support for the inference in the project management literature. If the inference could be found in project management standards or in standard textbooks[12], then I scored the evaluation with a "5". If the inference could be found in other project management literature[13], I scored the evaluation with a "4". If the analogy met the constraints of structural consistency, semantic similarity, and purpose, but I was not able to find any support in the project management literature, then I scored the evaluation with a "3". If the analogy could be applied but required adaptation of some type, they I scored the evaluation with a "2".

[12] See Appendix B for a list of referenced standards and standard textbooks

[13] See Appendix C for a list of referenced journals and texts

An inference that did not meet the constraints of structural consistency, semantic similarity, and purpose and therefore should not be applied was scored with a "1".

In the previous section, the proposition

Aligns-with(each-move, goal)

and its inference

Aligns-with(each-activity, goal).

were shown to adhere to the MT constraints. The mapped differences were identified in the Mapping step (for example, the mapping of move with activity). No unmapped differences were declared. However, this analogy is part of several potential ways of combining different analogies. E.g. it is contained within the higher-level principle "Balance global and local perspectives" (G06). It is also part of a breakdown of the proverb "look at the whole board". When a Go teacher tells a student to "look at the whole board", the teacher usually means to include at least the Go principles G01, G02, G03, G04, G05, G06, G11, G18, G19, G20, G26, G29, G48, G49, G50, G56, and G62 . One way to test this inference is to find it in standard PM literature – and it is there. "The 100% rule … states that the WBS includes 100% of the work defined by the project scope and captures ALL deliverables – internal, external, and interim – in terms of work to be completed, including project management." (Project Management Institute, 2006, p. 8).

Each principle in the game of Go is interrelated with all the others – some more directly than others. This is because every move impacts every future move (see G10 and G18) in an attempt to achieve the goal.

From the data, of the 83 propositions 32 low-level analogies were rated with a "5", 39 with a "4", 7 with a "3", 2 with a "2", and 3 with a "1".

Only two of the low-level analogies require adaptation. Of those, one is merely to accommodate different vocabularies between the game of Go and project management, and the other would provide another level of generalization to create an isomorphism. Because of the minor nature of these adaptations, they were then re-scored: G19 as a "5" and G35 as a "4".

4.3.1 Go Principles Already Part of Standard Project Management

After the rescoring due to adaptation, there are 33 analogies with a rating of "5", meaning that the inferences based on the game of Go have already been incorporated into the project management knowledge domain. The inferences for project management are:

1. Align every activity with the goal (G01)
2. Ensure every activity benefits the project (G02)
3. Do a SWOT analysis to understand the situation (G03)
4. Create something with each activity (G04)
5. High-level goals dominate lower-level objectives (G05)
6. Balance global and local perspectives (G06).
7. It takes unplanned time and/or resources to fix weaknesses (G07). The implication is to take more time for planning or allow for more redundancy or flexibility to handle weaknesses, and make allowance for this by allocating contingencies.

8. Perform many types of projects in a variety of settings to gain competence (G08)
9. Ensure each activity is consistent with both global and local perspectives (G09).
10. Every project is unique (G15)
11. Use all available resources to achieve the goal (G18)
12. Gather as much relevant information as possible to understand a situation in order to make good decisions (G19)
13. As situations develop and change, consider the need to reinforce weak or even stable positions (G21).
14. Balance risk and safety (G26)
15. Being able to plan well allows a project manager to do things right (G42)
16. Analyze different sequences of activities to find the best one (G45)
17. Attack the opposition in a way that increases value (G48)
18. Always know the status of the project (G49)
19. Understand the opposition's intentions to make better plans (G51)
20. Develop your abilities, and be confident using them (G52).
21. Balance positive and negative stakeholders (G54)
22. Members of teams need to communicate and coordinate (G56)
23. Take and keep the initiative (G61)
24. Be objective when analyzing information and making decisions (G64)
25. Control your emotions (G70)
26. Focus on a single objective when the situation is clear (G71)
27. Use influence to help create value in the future, or create value immediately (G74). The balance between them is partly a matter of style and partly constrained by the context.

28. Commit to completing each started objective (G75)
29. Planning is more important than the plan (G77)
30. Plan how to exit a situation before entering it (G79)
31. The project manager is responsible for all decisions (G81). Following rules, guidelines, etc. will ensure developing a good plan, but does not guarantee achieving the goal.
32. Do your best at all times (G82)
33. Know the goal (G83)

4.3.2 Go Principles Partially Incorporated into Project Management

40 analogies rated a "4", meaning that the inferences based on the game of Go have been incorporated to some degree into the project management knowledge domain, but not so much as to be common practice. The inferences for project management are listed below. See Table 10 for a little more explanation of each principle.

1. Consider how each activity will impact the future situation (G10). In dynamic conditions this has to be done frequently – not only at the beginning of a project or when a change request is submitted (as per TPM).
2. Explore new areas before attacking the opposition too strongly or investing too much on strengthening a stable position (G11). This is similar to (Loch et al., 2006)'s selectionism strategy.
3. Make flexible plans when the project context is dynamic (G13). This is one of the primary criticisms about TPM.

4. Plan actions that prepare for many eventualities (G14) (i.e. activities which will be useful in most of the likely future scenarios), allowing for future change due to learning or changes in context. This also implies that the project manager must be capable of handling many things at the same time.
5. In dynamic contexts, frequently re-evaluate and possibly change the project plan (G16).
6. Watch for and seize opportunities when they arise (G17). If the situation is dynamic, it is the most likely way to achieve the goal.
7. Understand the opposition's intentions to better understand the situation (G20). Note: SWOT analysis (G03) is necessary but not sufficient.
8. Actively adjust the exposure to risk (both up and down) according to the project status (G22).
9. To increase competence, a project manager must take greater risks than is comfortable (G23).
10. Opportunities are created by the opposition making mistakes (G24). Be patient and wait for them – without making mistakes yourself.
11. Constantly check the stability of each activity; fix unstable ones, then initiate new ones when all are stable (G25). Note that stability is a relative concept – relative to the opposition's positions rather than relative to the project plan.
12. When all efforts to achieve the goal will fail, terminate the project (G27).
13. Choose as the next activity the one that has the highest reward-to-risk ratio (G28). This implies doing activities with high, immediate value early, and also those that threaten the success of the project.
14. Balance the speed of development with stability (G29).

15. Do not push the opposition so hard that they initiate a ferocious counter-attack (G30).
16. Keep pressure on the opposition so it cannot achieve its goal, and distract it from preventing the project team from achieving the project goal (G31).
17. Keep pressure on the opposition in such a way that it helps the project team perform the most important activities to achieve the project goal (G32).
18. In dynamic situations, choose activities that have appropriate separation from other activities, allowing the project to be flexible and resilient (G35).
19. Time each activity to align not only with the project goal but also with the current priority (G36).
20. Each activity is a lost opportunity to do something else – do not waste it (G37).
21. Weaken a strong opposition by splitting it into smaller, weaker groups. Prevent the opposition from doing the same to the project (G38).
22. Produce value before considering an activity "done" (G39).
23. To gain a deeper understanding of a concept, unlearn what has already been learned (G40).
24. Practise planning to increase planning competence (G41). This helps a project manager to develop heuristics for dealing with new situations; to identify and prepare for potential threats; to see a weakness in the opposition's position that the opposition may not yet be aware of – and so take advantage of the opportunity; and to research more alternatives in a given time.
25. Increase competency by doing, then reviewing and fixing problems (G43).
26. Plan forward to find a way to achieve a goal or objective, then plan backward to find the best way forward (G46).

27. To advance in a field, first learn the basics, then confront your comfort zones, then develop your own unique approach. Repeat. (G53) Standard project management literature urges learning, but does not discuss double-loop learning, deutero learning, etc.
28. Improve competence by striving and overcoming adversity (G57).
29. Improve competence by listening to your mentor (G58).
30. Be willing to sacrifice some project activities to take advantage of an opportunity with a higher chance of achieving the project goal (G59)
31. In order to sacrifice something, a project manager requires a clear understanding of the objective and its relation to the goal (G60).
32. Analyze the project situation at a moment in time, and also its trajectory through time (G65).
33. Ensure that each activity has appropriate follow-on activities (G66).
34. Use a probe to gather information to clarify a situation (G67). Often it forces the opposition to commit to a plan of action thus clarifying the situation.
35. Taking the initiative is risky, but not doing so is more risky (G68).
36. Balance leading and following (G69). A project manager requires patience and a long view.
37. Look for activities that have multiple purposes, and preferably that are the best activities for each purpose (G73).
38. Maintain uncertainty and delay decisions as long as possible (G76) to allow time for information gathering and understanding of the situation and trajectory, and to allow the opposition to make mistakes.
39. Balance expansion and focus (G78).

40. Create uncertainty for the opposition (G80).

Most of these principles suggest how to deal with dynamic situations. Some also address other topics such as learning, dealing with risk, dealing with uncertainty, and dealing with strong opposition. These are discussed more in the next chapter.

4.3.3 Go Principles not part of Standard Project Management

Seven analogies were rated as a "3", meaning that the inferences based on the game of Go have not been incorporated into the project management knowledge domain. This implies that these principles may be new to project management. The inferences for project management are listed below. See Table 10 for a little more explanation of each principle.

1. Do not do something that would make it easy for the opposition to defend itself or to obstruct the project (G12).
2. Attack the opposition indirectly. Do not attack their strengths head-on, but build new strengths, e.g. as a base from which to attack later (G33).
3. When defending a position, it's acceptable to strengthen an opposition's position (G34).
4. Protect a weakness by attacking a weakness in the opposition (G47).
5. The best way to advance a project toward the goal is often also the best way for the opposition to thwart the project (G55).
6. If the opposition helps the project team achieve the goal, let it (G62).
7. When there are two equal opportunities it is not urgent to take either of them. But when the opposition takes one, take the other (G72).

Most of these principles assume a strong negative opposition (numbers 1-5 and number 7), but number 6 assumes a weak opposition. These are discussed more in the next chapter.

4.3.4 Go Principles that Should Not be Applied to Project Management

The three analogies that scored a "1" (should not be applied) are actually of some interest. The first one, G44, recommends failing frequently and learning from those failures. This is the same advice used and given by Thomas Edison (Forbes, 1921). This proverb can be interpreted in several ways – all appropriate. For example, (1) In projects with high uncertainty, use selectionism – learn what does not work, and what might work. This is the sense that Edison recommended. (2) At a portfolio level, quickly terminate projects that will not help meet the organization's strategic goals. (3) Apply learning from failures in other fields and by other people to one's own projects. This is a recommendation of this research. (4) Failure in projects <u>does</u> have serious consequences, so do not apply this analogy.

The second, G50, suggests that mistakes can be the source of opportunities. This requires the opposition to not notice the mistake so that it can be taken advantage of. This is risky and not recommended practice. In the game of Go, stronger players may use this technique intentionally to take advantage of weaker players. But if it is noticed, the opposition should take advantage of the mistake.

The last one, G63, recommends giving the opposition an equal opportunity to disrupt the project. Organizations invest in projects to make some beneficial change. Project sponsors ideally want a guaranteed positive result from their investment; they do not want an equal struggle. Consequently they should try to "stack the deck" by getting the best resources, sufficient funding, and so on – as well as the best project manager for each project. This is like a project manager playing as Black and taking some handicap stones – against an equal or weaker player. Finding the right project manager significantly increases the odds of achieving the desired results (see (Dinsmore & Cooke-Davies, 2006, pp. 87-88)).

Based on the above findings, a recommendation of "can be applied" can be applied to the high-level analogy of "project management is like the game of Go".

4.4 Learning

Previous sections of this chapter have shown many instances where the game of Go and project management are analogous. The multi-constraint theory of analogy and the more inclusive shared-structure theories of analogy insist that part of the reason for the success of analogies is because there is a similar causal structure between the source and target analogies (Gentner, 1983; Holyoak & Thagard, 1995; Itkonen, 2005). This section of the research identifies a shared structures between project management and the game of Go, and looks at it from three different perspectives – complex problem solving, game theory, and Taoism. Other perspectives that could be developed in future include complexity theory and general systems theory.

4.4.1 Shared Structure – Complex Problem Perspective

In this section the referenced Go principles often imply the characteristic rather than state it explicitly. A game of Go deals with:

- complicated situations (G41, G71), e.g. those that can be understood by taking the time to do so (reading, late endgame). Skill in reading will determine which situations are complicated and which are complex.
- complexity (G10), e.g. many parts interacting intricately, making it difficult to understand or predict system behaviour (Gonzalez, Vanyukov, & Martin, 2005))
- frequent change (G13) due to a player's actions, the opponent's actions, and feedback loops (e.g., influence and aji) between all groups on the board
- lack of transparency (G14, G76, G80), e.g. lack of information or inability to recognize patterns or intentions, and their future impacts on the goal and objectives
- conflict (G31, G32) due to multiple goals (G09, (G06, G26, G29, G46, G54, G69, G78, G81)) and strong opposition (e.g. G55, G57).
- creating something unique (G15), its value part of something bigger (G01, G02, G04, G05, G06, G39, G83), through transformative, purposeful activities
- vigilant (G37) monitoring and reinforcing of positions as time passes and situations change (G21)
- making decisions – under conditions of certainty, of risk, of uncertainty, and of conflict (Categories of decisions are from Meredith and Mantel (2009, p. 59))

- risk (G68, G81), i.e. "uncertainty that, if it occurs, will affect achievement of objectives" (Hillson, 2009, p. 7). Hillson uses the term "risk" to refer to randomness with knowable probabilities, and uses "uncertainty" to refer to randomness with unknowable probabilities (p.4). Risk, then is a function of complication, complexity, change, etc. listed in bullet points above.

As shown in previous sections, these characteristics also apply to project management.

These characteristics fit almost exactly to a definition and framework for complex problem solving (CPS) in Frensch and Funke (1995, 2002). Their definition states: "CPS occurs to overcome barriers between a given state and a desired goal state by means of behavioural and/or cognitive, multi-step activities. The given state, goal state, and barriers between given state and goal state are complex, change dynamically during problem solving, and are non-transparent. The exact properties of the given state, goal state, and barriers are unknown to solvers at the outset. CPS implies the efficient interactions between solvers' and the situational requirements of the task, and involves solvers cognitive, emotional, personal, and social abilities and knowledge." They go on to say "Our definition … constrains potential problems by requiring that they be (a) novel tasks that problem solvers are unfamiliar with, (b) complex, (c) dynamically changing over time, and (d) non-transparent." (Frensch & Funke, 2002, p. 4) The definition has since been updated to add the characteristic of having multiple goals (polytely) (Blech & Funke, 2010). They also point out that CPS is not deterministic – it may lead to a solution, it may help the solvers toward a solution, or it may not lead to a solution at all. This definition is used within their framework for complex problem solving – see figure in Frensch and Funke (1995, p. 22).

That figure summarizes the basic components of the framework and the interrelations among the components. The framework contains three separate components: problem solver, task, and environment. Frensch and Funke (2002, p. 12) described the framework this way

> In the problem solver, static memory content and dynamic information processing are distinguished. Memory is divided further into domain-general and domain-specific knowledge both of which affect CPS performance. Information processing includes the task strategies that are selected and the processes of task monitoring and progress evaluation. In addition, non-cognitive problem-solver variables such as motivation and personality also factor into CPS performance.
>
> The task itself is depicted in terms of the barriers that exist between a given state and a goal state. As noted above, the barriers are assumed to be complex, dynamically changing, and non-transparent; the transition from given to goal state is constrained by the problem solver's memory content and information processing, and by the tools that are available to the solver.
>
> The environment includes the resources available for problem solving, as well as feedback, expectations, cooperation, peer pressure, disturbances, etc. The environment affects both the problem solver and the task. It affects problem solver by constraining the information processes that can be used and by

influencing which knowledge is accessible. The environment affects the task by offering additional information, constraining which tools may be used, and so on. In addition, the environment can be changed actively by the problem solver but not by the task.

This framework for complex problem solving also maps very closely to the game of Go: the problem solver corresponds to the Go player, who uses domain-general knowledge (e.g. the Go principles used in this research) as well as domain-specific knowledge (e.g. rules, and many of the principles which I did not include in this research are domain-specific, such as "*hane* at the head of two stones"). The Go player processes information throughout the game, using static knowledge (e.g. principles and the board position) to develop objectives, strategy, and tactics (e.g. G01, G02, G04, G05, G09), as well as evaluating progress (G49) and applying and adapting knowledge to the particular situation (e.g. G16, G25, G59). Go principles also include non-cognitive variables such as motivation (G82), self-confidence (G52), self-control (G64, G70), and perseverance (G31, G32, G75). The environment for a game of Go consists of the resources used such as board and stones, and also their constraints – efficiency is required to generate more points than the opponent with the same number of stones / moves, and also to devise strategies and tactics within the limited time available (there is insufficient time left in the universe for a human or a computer to analyze all possible moves in even one game of Go). Within a game of Go, some other environmental factors are: plays made by the opponent (G31), feedback loops of influence from other groups of stones on the current (and future) situation (G10). Some of the environmental aspects of complex problem solving situations do not apply to the game of Go, such as expectations, cooperation and peer pressure – although they would apply to project management.

It should be pointed out that the definition of CPS used above is only a working definition used by those authors – there is no accepted CPS definition or theory within the complex problem solving field (Quesada, Kintsch, & Gomez, 2005).

This demonstrates that both the game of Go and projects share the structure of complex problems, and that playing Go and managing projects are situations requiring complex problem solving. It implies that methods for solving complex problems may apply to the game of Go and to project management. This is an area for future research.

4.4.2 Shared Structure – Game Theory Perspective

Another way to look at the game of Go and project management is from the perspective of game theory. Using game theory terminology defined by Allis (1994, pp. 5-6. 156-161), the game of Go is a two-person, zero-sum, diverging, perfect-information, fixed-termination game with far higher complexity than any other game he analyzed (Allis, 1994, p. 174). In lay terms, this means that it is a game between two people, only one can win, the number of legal game positions increases as the game progresses (it gets more complex), all information from previous plays is available to both players, there is no pre-specified game-ending pattern (e.g. no checkmate as in chess), its state-space complexity (the number of possible game positions) is approximately 10^{172}, and its game-tree complexity (the number of braches it would have to search to check all possible move combinations in a game) is approximately 10^{360}. By contrast, a project is a multi-person, non-zero-sum, diverging, imperfect-information, sudden-death game with even higher complexity than the game of Go. This means that it could be considered to be a game between any number of persons or teams, one team's gain is not necessarily another's loss, a project gets more complex as it progresses, a team does not have all information available to recreate the current situation, there is a defined ending pattern (e.g. create all the deliverables), and has nearly limitless possibilities when making any of the vast number of decisions made on any project.

Analyzing this comparison from the Multiconstraint theory perspective, the mapping of attributes is structurally consistent, as shown in the mapping below:

Game of Go	Maps to	Project
Two-person	↔	Multi-person
Zero-sum	↔	Non-zero-sum
Diverging	↔	Diverging
Perfect-information	↔	Imperfect-information
Fixed termination	↔	Sudden-death
High complexity	↔	High complexity

However, some of these attributes are not really clear-cut, and can be adapted to be a better fit. A game of Go is between two people; and from a project manager's project-blinkered perspective ("a prime quality of project managers is *tunnel vision* aimed steadfastly at achieving results" (Dinsmore & Cooke-Davies, 2006, p. 7)), a project is between the project team and the rest of the world, which can be considered to be a two-party game. A game of Go is zero-sum: gains made by one player detract from the other – at least regarding achieving the goal (e.g. win vs. lose); a project manager feels the same way with respect to achieving the goal of the project (e.g. success vs. failure). A game of Go is diverging, i.e. the situation gets more complex as the game progresses; the situation is the same for projects – at least those in dynamic environments. A Go player has perfect information about what has occurred in the past – but it is of only limited help in making decisions that affect the future; a project manager only has incomplete information – not knowing all the decisions that have been made that have been made in the past about the project – creating even more uncertainty regarding decisions affecting the future. The end of a game of Go is agreed upon by the players, there is no other pre-defined criteria (other than a time constraint such as in a tournament); a project is supposed to have defined completion criteria, but projects infrequently produce what was originally specified (e.g. (Standish Group, 1995), and sometimes continue indefinitely or terminate in other non-predefined ways, e.g. (Meredith & Mantel, 2009, pp. 552-555). A game of Go is highly complex – it has been determined to be "EXPTIME-complete"(Tromp & Farnebäck, 2009), i.e. infeasible to solve using current technology and processes; projects have even more options at every decision-point than a game of Go. This adaptation of the analogy shows that from a project manager's perspective, a project has similar attributes to those of a game of Go. The purpose of both a Go player and a project manager (including the project team) is to achieve the goal, and the purpose of the analogy is to identify principles used to do so in a game of Go in order to apply them to project management.

The evaluation of this analogy (using game theory) between the game of Go and project management indicates that the analogy can be applied. This indicates that further research is warranted into this analogy, perhaps using more specific game theories and their derivatives such as metagame analysis (Howard, 1986), drama theory (Bryant, 2010), and graph models (Kilgour & Hipel, 2005).

4.4.3 Shared Structure – Taoist Perspective

A third way to look at the game of Go and project management is from the perspective of Taoism. From this perspective, the focus is on adapting and thriving in the fluid, structural changes we experience of the unchanging reality. Section 2.1.4 identified many similarities between Taoism and the game of Go. In this section we add project management.

1. *Tao* is the unchanging, unnameable absolute Reality. From *Tao* comes One, the cosmic energy of *qi*, a concentration of powerful creative potential. From *qi* comes the two, *yin* and *yang*. The sophisticated and complex combinations of varying degrees of *yin* and *yang* bring about the whole of the material world and all the ever-changing subtleties contained within it. | A game of Go is an expression of creation (G04) – of *qi* changing from potentiality to reality through the interplay of *yin* and *yang*, of black (*yin*) and white (*yang*), of square (*yin*) board and round (*yang*) stones. | A project is an expression of creation – of changing potential to reality.
2. All things are equal. | In the game of Go, all the stones are of equal value – none are intrinsically more important than any others. | All things needed on a project are needed equally – without each the project goal could not be achieved.
3. There are recurring patterns (e.g. night & day, life & death, seasons). | In the game of Go, similar patterns occur in game after game. This is also seen in, for

example, one player taking the lead for a while but having to give it up to the other player (G69), or in patterns of play in the corners (*joseki*) (e.g. (Y. Ishida, 1977a, 1977b, 1977c)) or in patterns of skillful play in the rest of the board (*tesuji*) (e.g. (Fujisawa, 2004, 2005, 2006, 2007). | In projects there are recurring patterns, the most obvious being the project life cycle (Morris, 2002).

4. Balance can be seen at the centre of all opposites. | A Go player tries to balance all the dimensions of the game (e.g. GO'S RULES – G06, G26, G29, G46, G54, G69, G78, G81). | Project managers try to balance the triple constraints of cost, time and scope/quality. They also balance the needs and wants of the various stakeholders of the project. The balancing of GO'S RULES (G06, G26, G29, G46, G54, G69, G78, G81) also applies to project management.
5. *Te* represents the processes of change and transformation in all things – the shifting and dynamic nature of reality. | This dynamism is played out in every game of Go. (G15, G16) | A project by most definitions is about change and/or transformation. TPM largely ignores that the rest of reality changes at the same time, but Go principles (and other project management practices such as Agile and MAP) do not.
6. Going with the flow of *Te*, and not against it, is the aim of the sage. | The same is true for the Go player. Takemiya Masaki, a former top player in Japan with the ninth most Japanese titles and fourth most world championships (Power, 2011), advised "more important than winning or losing is playing your own game, playing the moves that you feel are right. If you're too worried about winning and losing you can get too focused on what you think might be the right move and you often lose that way. If you can relax a little bit and have fun with it, very

often you'll find you're playing the right moves naturally. This is true whether you're amateur or pro, Japanese or foreigner, for everybody." (Garlock, 2008). | This is not true of traditional project managers, who ideally have "tunnel vision" (Dinsmore & Cooke-Davies, 2006, p. 7). Following this Taoist principle is recommended by management writers such as Stacey (2001) and Stacey, Griffin and Shaw (2000), and through them to projects by, for example, Cicmil et al. (2009).

7. Minimal action to achieve the goal. Taoism encompasses the idea of *wu-wei* – the art of accomplishing much with the minimum of activity, the ability to act with minimum forced effort … *Wu-wei* is knowing, too, just the right amount to act and when to withdraw. | Go players struggle to achieve this balance – it is the motivation behind Go principles (G45) and (G46), and (G79). | There is a strong emphasis on efficiency in project management, but not quite the concept of *wu-wei.* Koskela's Flow perspective (Koskela, 2000; Koskela & Howell, 2002b) is close to this principle.
8. The sage is in control of emotions – by appreciating simplicity, realizing one's true nature and curbing selfishness and desire. With the deeper understanding that real knowledge of *Tao* brings, the ego is transcended, the emotions are controlled, and the self is not swayed by this and that of existence. | The Go player is also admonished to control thinking and emotions (G64, G70). | The project manager is also admonished to control emotions (e.g. the Self-control competence element in the ICB), but only to the level required to manage people and projects – not necessarily to the level of knowledge of *Tao*.

9. *Qi* can mean the air that we breathe, and the breath itself, it can also be indicative of energy and vitality. | Go players sometimes use the same terms to describe the needs of groups of stones for liberties / eyes / windows / breath to live. | According to Stacey, organizations have a life of their own, and as projects can be considered to be temporary organizations (J. R. Turner & Müller, 2003), they do, too. They need energy (e.g. resources) and breathing room (at least in conceptual space (Gardenfors, 2004)).
10. *Yin* and *yang* are complementary, not in opposition to each other. They cannot exist without each other, and they contain an element of the other within them. *Yin* is the yielding, receptive aspect of life; *yang* is the active principle. | In the game of Go, White and Black need each other, and some stones even change "owners" during the game – as they are sacrificed or captured, and perhaps recaptured (G54). Also, leading and following are both required, and need to be balanced (G61, G62, G69) | There is an ebb and flow to projects; there are times to be passive, and times to be aggressive; times to learn, and times to take action. These are some examples of the *yin* and *yang* experienced in projects.
11. Everything is related to everything else. | In the game of Go, each stone or group has an effect on every other group (G10) | In projects, all people, activities and resources are demonstrably interconnected. In TPM, the project is usually considered largely separate from its context, but Go principles strongly recommend also considering the connections between the project and its context.
12. There are no absolutes. | There are no rules (G81). | The project manager is assigned responsibility for achieving the project goal and must answer to higher

authorities. However, there is always flexibility – within the given constraints, and usually even of the constraints.

4.4.4 Summary

Game theory, complex problem solving, and Taoism all share the same shared structure common to the game of Go, and project management. Table 9 illustrates this.

Table 9. Structural similarities

Game of Go	Project management	Complex problem solving	Game theory	Taoism
Conflict, multiple goals	Conflicting priorities	Barriers, multiple goals	2-person, zero-sum – leading to conflict	*Yin-yang*; not conflict but mutual dependence
Frequent change	Frequent change	Dynamically changing over time	Diverging	*Te* / change
Lack of transparency	Lack of transparency	Non-transparent	Imperfect information	*Tao*, no absolutes, but there are patterns, need for balance
Opponents agree to end the game	Evolutionary development (Andersen, 2006, p. 20)	Often the optimal solution is unknown	Fixed termination	Go with the flow of *Te*
Complex	Complex	Complex	Complex	Everything is related
Unique	Unique	Novel	Novel	Novelty is implied as a result of all other aspects

As a result, processes and solutions from one of these fields may apply to the others.

The next chapter extends the results of the Evaluating and Learning steps to combinations of principles and how to deal with various situations.

Table 10. Analogy between the game of Go and project management

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G01	Consider the global context [look at the whole board – one aspect is "Align each move with the goal"]	Aligns-with(each(move), goal)	Aligns-with ↔ Aligns-with move ↔ activity goal ↔ goal	Aligns-with(each(activity), goal)
G02	Consider the global context [look at the whole board] [one aspect is "Ensure each move benefits the goal"]	Measurably-benefits(each(move), goal)	Measurably-benefits ↔ Measurably-benefits move ↔ activity goal ↔ goal	Measurably-benefits(each(activity), goal)

Evaluation	Comments
5	Selection: The purpose of actions in both the game of Go and project management should support achieving the goal. Mapping: Structure is 1:1; Similarity – Go <ins>move</ins> is mapped to PM <ins>activity</ins> because a move is the smallest manageable unit in a game of Go, and an activity is the smallest manageable unit in a project. The <ins>goal</ins> in a game of Go (to gain more points than the opponent) is different from the <ins>goal</ins> in a project (to create a specific unique product, service or result), although the meaning of "goal" is the same in both Go and PM. Purpose of the principle is the same for both Go and PM. Inference: In project management, align every activity with the goal. Evaluation: The following adaptation is also possible in order to eliminate the potential confusion regarding "goal": each of these goals could be redefined as "create the highest value for the client" in which case no further substitution or interpretation is needed. Consequences: One way to test this inference is to find it in standard PM literature – and it is there. "The 100% rule … states that the WBS includes 100% of the work defined by the project scope and captures ALL deliverables – internal, external, and interim – in terms of work to be completed, including project management." (Project Management Institute, 2006, p. 8). Learning: Each and every activity should be purposeful.
5	Selection: In both the game of Go and PM, each activity should have a positive impact on achieving the goal Mapping: Structure is 1:1; Similarity – See G01 comments; Purpose of the principle is the same for both Go and PM. Inferences: Ensure every activity benefits the project Evaluation: this inference is a corollary of the 100% rule (See G01 comments). Learning: Each and every activity should be beneficial.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G03	Understand local positions; Four questions [Do a SWOT analysis]	Cause{ Cause{ AND[Identify(player, OR(strong,weak) status (player(position))), Identify(player, OR(strong, weak) status(opponent (position)))], Identify(player, AND(opportunities, threats)) }, Help-choose(player, next(move)) }	Identify ↔ Identify player ↔ project-manager player ↔ project position ↔ position status ↔ status strong ↔ strong weak ↔ weak opponent ↔ opposition opportunities ↔ opportunities threats ↔ threats next ↔ next move ↔ activities Helps-choose ↔ Helps-choose	Cause{ Cause{ AND[Identify(project-manager, OR(strong,weak) status (project(position))), Identify(project-manager, OR(strong, weak) status(opposition (position)))], Identify(project-manager, AND(opportunities, threats)) }, Help-choose(project-manager, next(activities)) }

Evaluation	Comments
5	Selection: In both the game of Go and PM, a SWOT analysis is used to help evaluate a situation. A Go player identifies the strong and weak positions of both players, then identifies threats that the player is vulnerable to and opportunities to take advantage of the opponent. The player uses this information to help choose the next move. Mapping: Structure is 1:1, but not isomorphic – player is mapped to both project manager and project; Similarity – Go player is mapped to project manager because that is the person responsible for achieving the goal. Go player is also mapped to project in the sense that a player's position on the board at a point in time can be compared to a project's status at a point in time. Go opponent is mapped to project opposition – i.e. anything that obstructs the project team from achieving the goal. Purpose of the principle is the same for both Go and PM. Inferences: A project manager should do a SWOT analysis to understand the project situation: identify the project's, and the opposition's strong and weak positions, then identify threats that the project is vulnerable to and opportunities to take advantage of the opposition. The project manager should use this information to help decide which activities to perform – during the execution of a project. Evaluation: SWOT analysis is a standard project risk management tool (Project Management Institute, 2008a, p. 288). Learning: Do SWOT analyses frequently during a project.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G04	Every stone counts [Each move helps build the goal]	Builds(each(move), goal)	Builds ↔ Builds move ↔ activity goal ↔ goal	Builds(each(activity), goal)
G05	Change between local and global perspectives; [Global perspective dominates local perspectives]	Dominates(global(perspective), (local(perspective))	Dominates ↔ Dominates global ↔ global local ↔ local perspective ↔ perspective	Dominates(global(perspective), (local(perspective))

Evaluation	Comments
5	Selection: In both the game of Go and PM, each activity should produce something that will help achieve the goal Mapping: Structure is 1:1; Similarity – See G01 comments; Purpose of the principle is the same for both Go and PM. Inferences: Each activity should create something that will help achieve the goal Evaluation: This is a corollary of the 100% rule (See G01 comments). Other ways to word this could be: "Small successes build toward the goal" or "tactics support strategy". Differences (unmapped): one aspect of G01, G02 and G04 together is to "turn vision into reality" or "build reality". Learning: Every activity should create something.
5	Selection: In both the game of Go and PM, strategy takes precedence over tactics. Mapping: Structure is 1:1; Similarity – the same; Purpose of the principle is the same for both Go and PM. Inferences: Strategy takes precedence over tactics, i.e. project goal supersedes an activity goal, and the portfolio goal supersedes the project goal. Evaluation: This is a corollary of the 100% rule (See G01 comments). It is also clear in the process of selecting projects in portfolio management (Project Management Institute, 2008a, pp. 7-11). Learning: Higher-level goals dominate lower-level objectives.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G06	Balance global and local perspectives	Keep-balance-between(AND(global(perspective), local(perspective)))	Keeps-balance-between ↔ Keeps-balance-between global ↔ global local ↔ local perspective ↔ perspective	Keep-balance-between(AND(global(perspective), local(perspective)))
G07	Take your medicine [Weaknesses require unplanned effort to fix]	Cause [player(weak(position)), make(player, extra(move))]	player ↔ project weak ↔ weak position ↔ position make ↔ make player ↔ project manager extra ↔ extra move ↔ activities	Cause [project(weak(position)), make(project-manager, extra(activities))]

Evaluation	Comments
5	Selection: In both the game of Go and PM, achieving the goal requires attention to both strategy and tactics. Mapping: Structure is 1:1; Similarity – the same; Purpose of the principle is the same for both Go and PM. Inferences: Balance the global and local perspectives. Evaluation: This is a corollary of Change Control (Project Management Institute, 2008a). It is stated explicitly in Frame (2002, p. 13). Learning: Both tactics and strategy are important; achieving the goal requires constant attention to both.
5	Selection: In both the game of Go and PM, additional time and/or resources are required to fix weaknesses. Mapping: Structure is 1:1, but not isomorphic – see G03; Similarity – see previous comments; Purpose of the principle is the same for both Go and PM. Inferences: It takes extra time and/or resources to fix weaknesses... Evaluation: Identifying project weaknesses through SWOT, monitoring performance, etc. leads to the need to modify planned activities. This is implied in processes such as Direct and Manage Project Execution, Monitor and Control Project Work, and Perform Integrated Change Control (Project Management Institute, 2008a). Learning: The project has to pay for taking risks or making mistakes – sooner or later – by taking the time and resources to fix them.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G08	To ingrain a rule you often have to fail [Gain competence with a variety of experiences]	Cause [Play (player, games), gain(player, competence)]	Play ↔ Manage player ↔ project manager games ↔ projects gain ↔ gain competence ↔ competence	Cause [Manage (project-manager, projects), gain(project-manager, competence)]
G09	Don't play chutto hampa (lukewarm moves) [Ensure each move is consistent with both strategic and tactical perspectives]	Consistent-with-both(each(move), AND(global(perspective), local(perspective)))	Consistent-with-both ↔ Consistent-with-both move ↔ activity global ↔ global local ↔ local perspective ↔ perspective	Consistent-with-both(each(activity), AND(global(perspective), local(perspective)))

Evaluation	Comments
5	Selection: In both the game of Go and PM, increasing competence requires experience with many opponents. Mapping: Structure is 1:1; Similarity – The go player <u>plays</u> <u>games</u> while the project manager <u>manages</u> <u>projects</u>; Purpose of the principle is the same for both Go and PM. Inferences: A project manager gains competence by performing many types of projects in a variety of settings. Evaluation: This is in standard PM literature: e.g. a person gains experience from having a variety of experiences (Caupin et al., 2006, pp. 7,12; Highsmith, 2004, p. 167). A person only learns by making mistakes (H. Dreyfus & Dreyfus, 2005, p. 782). Learning: A project manager gains competence by performing many types of projects in a variety of settings.
5	Selection: In both the game of Go and PM, each activity should be consistent with both the global and local perspectives. This can also be stated in the negative – "Don't be inconsistent". Mapping: Structure is 1:1; Similarity – See G01 comments; Purpose of the principle is the same for both Go and PM. Inferences: Each activity should be consistent with both the global and local perspectives. Evaluation: This inference is a corollary of the 100% rule (See G01 comments), and implied in processes such as Direct and Manage Project Execution, Monitor and Control Project Work, and Perform Integrated Change Control (Project Management Institute, 2008a). Consequences: A dynamic environment makes this difficult when using TPM – e.g., previously planned activities are no longer consistent with the global perspective (e.g., see Frame (2002, pp. 44-45)). Learning: Ensure that each activity is consistent with both the global and local perspectives – especially in dynamic conditions.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G10	See the interconnections; never hurt your own stones; once you see a solution - look again [Consider the future implications of moves before making them]	Impact(local(action), future(situation)): a When [Consider(player, a), Plan(player, potential(move))]	Impact ↔ Impact local ↔ local action ↔ action future ↔ future situation ↔ situation Consider ↔ Consider player ↔ project-manager Plan ↔ Plan potential ↔ potential move ↔ activity	Impact(local(action), future(situation)): a When [Consider(project-manager, a), Plan(project-manager, potential(activity))]

Evaluation	Comments
4	Selection: In the game of Go, a player considers how local actions will impact the future situation; then tests the theory before committing to it. I noted that the TPM method I used did not allow for this. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same for both Go and PM. Inferences: A project manager should consider how each activity will impact the future situation; then test the theory before committing to it. Evaluation: In TPM this is done during the planning phase (e.g. schedule activities), but to implement this principle during execution a project manager must rely on change control (Project Management Institute, 2008a). This principle is incorporated into Agile methodologies by allowing changes to the product backlog before starting the next sprint (Schwaber, 2004). Differences (unmapped): part of *haengma* – see G29 Learning: Look for ways an activity can strengthen connections between separate stakeholders/ products/ projects; look for ways an activity can interrupt opposition's connections; look for the potential flow. If the context is dynamic, use a methodology that allows for continuous changes.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G11	Play away from strength.	Distant-from(move, strong(position))	Distant-from ↔ Distant-from move ↔ move strong ↔ strong position ↔ position	Distant-from(move, strong(position))
G12	Don't help your opponent play perfectly	does-not-help(move, opponent)	Does-not-help ↔ Does-not-help move ↔ activity opponent ↔ opposition	does-not-help(activity, opposition)

Evaluation	Comments
4	Selection: In the opening and early midgame in a game of Go, playing too close to a player's own position is inefficient, and playing too close to the opponent's position is ineffective. Perhaps a similar tactic is true for project management. Mapping: Structure is 1:1; Similarity – same; Purpose of the principle is the same for both Go and PM. Inferences: Early in a project, explore new areas before attacking the opposition too closely or spending too much time on strengthening a stable position. Evaluation: Feasibility studies are often done as a separate project, as pre-project work, or as the first phase in a project (NASA, 2007, pp. 22-24; Project Management Institute, 2008a, p. 19). If there are unexpected difficulties, then a change may be needed (see G07). This principle is incorporated into some Agile methodologies by pursuing high risk activities early in a project, e.g. (Wysocki, 2007, pp. 409-411). Project managers often try to attack (significant) opposition as early and as tightly as possible (Gido & Clements, 2006, pp. 80-83), but this principle recommends against doing that. Related to G35 Learning: Early in a project, explore new areas before attacking the opposition too closely or spending too much time on strengthening a stable position.
3	Selection: Weaker Go players often violate this principle. It seems obvious, but by not planning ahead, they do not realize that they often help the opponent, and even damage their own position at the same time. The same thing can happen to project managers. Mapping: Structure is 1:1; Similarity – See G01 comments; Purpose of the principle is the same for both Go and PM. Inferences: Plan ahead so that stakeholders do not do something that would make it easy for the opposition to defend itself or to obstruct the project Evaluation: I have not seen this in PM literature. Learning: Do not do something that would make it easy for the opposition to defend itself or to obstruct the project

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G13	Don't get attached to your first moves or plans [Make flexible plans when the context is changeable]	When{ Plays(player, flexible(move)), AND[NOT(know) (player, ultimate (location(territory))), NOT(know) (player, ultimate (size(territory))), NOT(know) (player, ultimate (total-required-size(territory)))] }	Plays ↔ Plans player ↔ project-manager flexible ↔ flexible move ↔ activity know ↔ know ultimate(location(territory)) ↔ detailed(requirements) ultimate(size(territory)) ↔ detailed(requirements) ultimate(total-required-size(territory) ↔ detailed(requirements)	When{ Plans(project-manager, flexible (activity)), NOT(know) (project-manager, (detailed(requirements))) }

Evaluation	Comments
4	Selection: Because the game of Go is so dynamic, a Go player makes flexible moves. Dynamic projects need the same ability. Mapping: Structure is not 1:1; Similarity – See previous comments, plus detailed requirements in a game of Go (e.g. the location and size of each territory, plus the combined required total required size of territory to win the game) are not (and cannot be) known at the beginning of a game, and will not be known until the game is over. Similarly, in projects in unstable contexts, the detailed requirements will not be known at the beginning of the project; Purpose of the principle is the same for both Go and PM. Inferences: Make flexible plans when the project context is dynamic Evaluation: This is one of the criticisms of TPM in the literature, e.g. (Frame, 2002; Shenhar & Dvir, 2007; Williams, 1999). PM iterative and incremental methods were developed to try to deal with dynamic contexts, with varying degrees of success. Putting them together and adding a couple of tweaks (incorporating feedback and user prioritization) creates Agile methods (Aguanno, 2004, pp. 77-82), which incorporate this principle. Adaptation: The Go predicates referring to location, size and total required size of ultimate territory could be replaced with the more generic "(detailed(requirements))", allowing the mapping to PM to be structurally 1:1 and also semantically similar. Learning: The project manager and the project plan must be flexible to deal with dynamic, uncertain situations. This principle identifies one of the fundamental differences between TPM and the game of Go – that the context is dynamic, not stable.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G14	Play light in the opponent's territory. Expand your perspective; Expand the scope of your initiatives [Prepare for many possibilities by playing flexible moves]	Prepares-for(Flexible(move), many(possibilities))	Prepares-for ↔ Prepares-for flexible ↔ flexible move ↔ activity possibilities ↔ possibilities	Prepares-for(Flexible(activity), many(possibilities))
G15	Every Go game is unique	Unique(every(game))	unique ↔ unique game ↔ project	Unique(every(project))

Evaluation	Comments
4	Selection: Flexible moves prepare for a number of potential futures (not just one, but also not all possible futures). This principle encourages exploring new areas / technologies / processes – especially in the early part of the game, but also recommends being flexible throughout the game. This is also a principle for aggressively dealing with human opposition – out-play them. Top pros can have nine inter-related conflicts going on at the same time, weak amateurs can only handle one at a time. Mapping: Structure is 1:1; Similarity – See G01 comments; Purpose of the principle is the same for both Go and PM. Inferences: Plan actions that prepare for many eventualities. Evaluation: G13 acknowledges that there is instability; this principle (G14) is one that describes how to deal with instability – i.e. flexibility. There are two aspects: multi-purpose moves (see G73) (Learning per Loch et al. (2006)) and this principle – expand options by using Selectionism per Loch et al. (2006) and Laufer (2006)). If the context is stable, though, this principle is not efficient – in that case use G71. Learning: Plan activities which will be useful if any likely scenario occurs, allowing for future change due to learning or changes in the context. The project manager must be capable of handling many things at the same time (Andersen, 2006; Bluedorn, Kalliath, Strube, & Martin, 1999).
5	Selection: Every game of Go is unique Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same for both Go and PM. Inferences: Every project is unique Evaluation: This is part of many definitions of a project, e.g. (Project Management Institute, 2008a, p. 5; Wysocki, 2009, p. 6). Learning: Every project is unique

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G16	Plan to discard the plan – based on G14; Don't fall into your plans; the one goal is all that matters [Change plans when the context changes]	When(change(plan), changes(context))	change ↔ change plan ↔ plan context ↔ context changes ↔ changes	When(change(plan), changes(context))
G17	Strike while the iron is hot [Take advantage of opportunities]	Takes-advantage-of(player, opportunities)	Takes-advantage- of ↔ Takes- advantage-of player ↔ project- manager opportunities ↔ opportunities	Takes-advantage-of(project-manager, opportunities)

Evaluation	Comments
4	Selection: In both the game of Go and PM, the situation changes every time one of the players makes a move. Many of the opponent's moves force a player to re-evaluate existing plans, and often to make new ones. Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same for both Go and PM. Inferences: When the project context changes, re-evaluate and possibly change the project plan. Evaluation: TPM assumes a stable and deterministic environment, but allows for changes when required via the Integrated Change Control process (Project Management Institute, 2008a). But when the context is changing quickly, the TPM change process cannot keep up (Dvir & Lechler, 2004). Agile methods with their planning and reviewing meetings before and after each sprint go part-way to addressing this principle (Schwaber, 2004). Learning: In a dynamic context, the project plan needs to be re-evaluated and possibly changed frequently.
4	Selection: A player must watch for and seize opportunities when they arise just to have a chance of winning. Not doing so ensures a loss. Projects do not do this enough Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same for both Go and PM. Inferences: A project team must watch for and seize opportunities when they arise just to have a chance of achieving the goal – if the context is at all dynamic (i.e. more dynamic than the project contingencies allow for). Evaluation: Risk has both positive and negative impacts on achieving project objectives (Chapman & Ward, 2002; Hillson, 2009; Project Management Institute, 2008a). Many PM risk management methods ignore opportunities, e.g. Project Management Institute (2008a) and Wysocki (2009). Some argue strongly to incorporate opportunities, e.g. Chapman and Ward (2002) and Hillson (2009). Learning: Take advantage of opportunities when they arise – they may not last long. Taking advantage of opportunities is the only way to achieve project success in an unstable environment (Wysocki, 2009, p. 441), because danger lurks everywhere (Tannert et al., 2007), and sometimes materializes as unforeseen events, lack of trust, ambiguity, etc. (Chapman & Ward, 2002).

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G18	Stones become fixtures; Don't anchor your stones; Stones don't move; Once a stone has done its job, it's served its purpose; you can't undo the past; [Use all available resources, including previous moves]	Takes-advantage-of(player, previous(moves))	Takes-advantage-of ↔ Takes-advantage-of player ↔ project-manager moves ↔ activities	Takes-advantage-of(project-manager, previous(activities))

Evaluation	Comments
5	Selection: This sounds obvious, but in a game of Go stones are distributed around the board, with several areas that are not completely resolved until the end of the game. A weaker player will often concentrate on only a local area, forgetting about the rest of the board and where other stones are located. With a whole-board view, a player may be able to find additional alternatives to consider (see decision-making process in the main document) Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same for both Go and PM. Inferences: Take advantage of previous activities. Evaluation: This is true but obvious for a stable environment (see Sequence Activities process in Project Management Institute (2008a). The same process also applies to dynamic environments, but this principle is a reminder to remember all previous work, whether from within the project (including activities started but not finished, from the past (e.g. Lessons Learned), and from elsewhere (e.g. organizational history)). Learning: Use all available resources to achieve the goal.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G19	"Brutal honesty wins more games than hope." [Gather all relevant information to gain a clear understanding of a situation in order to make good decisions]	Cause[Has(clear(understanding), situation), Make(player, good(decisions))] Consists-of(situation, all(player(groups)), all(opponent(groups)), all(open(areas)))	Clear ↔ Clear understanding ↔ understanding situation ↔ situation Make ↔ Make good ↔ good player ↔ project-manager decisions ↔ decisions player(groups) ↔ relevant(information) opponent(groups) ↔ relevant(information) open(areas) ↔ relevant(information	Cause[Has(clear(understanding), situation), Make(project-manager, good(decisions))] Consists-of(situation, all(relevant(information)))

Evaluation	Comments
2 (5)	Selection: The more completely a situation is understood, the more likely that a player will make a good decision on where to move next. Mapping: Structure is 1:1; Similarity –In both projects and the game of Go, a clear understanding of the situation is required to make good decisions. In the game of Go, some of the relevant information consists of the status of each of the player's groups, each of the opponent's groups, and the open areas of the board (others include relationships between each of the groups, the flow of the game, and the player's and opponent's intentions). In projects, all relevant information depends on the project, but includes the status of each of the deliverables, the flow of work, etc. See also G01comments.; Purpose of the principle is the same in both Go and PM. Inferences: A project manager should gather as much relevant information as possible to get a clear understanding of the situation in order to make good decisions. Evaluation: Projects by definition exist in conditions of uncertainty (Project Management Institute, 2008a, p. 17; Winch, 2004). Knowing what to do next requires making a decision, especially in a dynamic situation. One of the first steps in making a decision is gathering information to reduce the uncertainty (Cleland & Ireland, 2010). E.g. SWOT analysis to see what's on the board (G03), and analyze play to understand the opposition (G20, G51, G65, G67, G76). It is not possible to collect all relevant information needed (Wildavsky, 1988; Winch, 2004). Adaptation: The Go predicates referring to groups and open areas could be replaced with the more generic "all(relevant(information))", allowing the mapping to PM to be structurally consistent (isomorphic). Consequences: The game of Go is considered a "complete information" game, but a player still does not know the plans and intentions (or capabilities) of the opponent. In projects (and the rest of the 'real world'), there cannot be complete information about any situation. Learning: Gather as much relevant information as possible to understand a situation in order to make good decisions

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G20	You cannot know the opponent's mind just by seeing the opponent's stones [Understand the opponent's intentions to better understand a situation]	Cause[Understand(player, opponent (intentions)), understand(player, situation)]	Understand ↔ Understand player - ↔ project-manager opponent ↔ opposition intentions ↔ intentions situation ↔ situation	Cause[Understand(project-manager, opposition (intentions)), understand(project-manager, situation)]
G21	Small leaks can become a great river [Weak positions become weaker]	Becomes(weak(position), weaker(position))	Becomes ↔ Becomes weak ↔ weak position ↔ position	Becomes(weak(position), weaker(position))

Evaluation	Comments
4	Selection: The more clearly the opponent's intentions are understood, the better a player can understand the situation. Mapping: Structure is 1:1; Similarity – See G02 comments; Purpose of the principle is the same in both Go and PM. Inferences: Understand the intentions of the opposition to gain a better understanding of a project situation. Evaluation: Gathering competitive intelligence is a basic management strategy mentioned in PM literature (e.g. Prescott and Smith (1987)), and also implied by several sources discussing stakeholder management, e.g. Pinto (1996), Daniel (2007), and Hiatt (2006). Learning: A SWOT analysis is a good start to understanding a situation, but not enough for a complete understanding; a project manager also needs to know stakeholders' intentions.
5	Selection: A weak position (or even a stable one) becomes weaker as the surroundings are developed, especially if the opponent has thickness / influence in the area. Without reinforcement, it may be captured (see G07). Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: A weak position becomes weaker over time without reinforcement. Evaluation: This principle is implied in risk and issue management. It is closely related to G07, G25, and G47. See also G10. Learning: Stable positions can become weak and weaknesses become weaker if not reinforced as strong positions develop around them.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G22	Adjust risk according to the score	When [Greater-than(player(points), opponent(points)), Reduce(player, risk), Else [Increase(player, risk)]]	player(points) ↔ expected(value) opponent(points) ↔ goal Reduce ↔ Reduce player ↔ project-manager risk ↔ risk Increase ↔ Increase	When [Greater-than(expected(value), goal)), Reduce(project-manager, risk), Else [Increase(project-manager, risk)]]

Evaluation	Comments
4	Selection: When behind, a player needs to take more risks and hope the opposition makes a bigger mistake in the complications that ensue. When ahead, a player should reduce risk by fixing weaknesses / playing solidly / playing *honte.* Mapping: Structure is 1:1; Similarity – The score at any time during a game of Go is the difference between the estimate of a <u>player's points</u> and those of the <u>opponent's points</u>. The goal is for the player to have more points than the opponent. This is similar to the status of a project using earned value analysis: The <u>expected value</u> of the project can be measured using the schedule performance index (SPI), the cost performance index, and the estimate-at-complete (EAC), then comparing these to the goal of SPI = 1, CPI = 1, and EAC = budget. In both Go and projects, the estimate is always approximate (until the end); Purpose of the principle is the same in both Go and PM. Inferences: If a project is behind schedule and/or over-budget, the project manager should take on more risk and hope the opposition allows it. When ahead of schedule and under-budget, a project manager should minimize risk. Evaluation: Earned Value analysis (or burn-down charts in Agile) provides the status of projects. If over-budget or behind-schedule, then the PM must implement actions that still might achieve the goal – but at higher risk of failure (e.g. crashing or fast-tracking) (Project Management Institute, 2008a). Agile methods suggest performing high-risk activities early (Hillson, 2009, p. 70). I have not seen anywhere describe the opposite situation: to reduce risk when ahead of schedule/ under-budget. Learning: Adjust risk according to the project status.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G23	You have to risk to gain [Take risks to gain competence]	Cause[take(player, risk), increase(player, competence)]	Takes ↔ Takes player ↔ project-manager risk ↔ risk increases ↔ increases competence ↔ competence	Cause[take(project-manager, risk), increase(project-manager, competence)]
G24	The board does not confer advantage, the opponent does. [Opportunities are created by the opponent making mistakes]	Cause[opponent(weakness), opportunity]	opponent ↔ opposition weakness ↔ weakness opportunity ↔ opportunity	Cause[opposition(weakness), opportunity]

Evaluation	Comments
4	Selection: To increase in competence, a player must take greater risks than is comfortable Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: To increase in competence, a project manager must take greater risks than is comfortable. Evaluation: H. Dreyfus and Dreyfus (2005) describe a 5-stage model of skill acquisition that Dinsmore and Cooke-Davies (2006) apply to project management. Learning: To improve at managing projects a project manager needs to take risks (G23). A project manager also needs a variety of experiences (G08), to try new things (G53), to take on greater challenges (G57), to fail and then succeed (G44), to reflect on those failures (G45), under the tutelage of a mentor (G58), and continually strive to do better (G82).
4	Selection: Opportunities are created by the opponent's weakness (e.g. by not playing the best move). Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Opportunities are created by the opposition (e.g. not making the strongest obstruction to the project, splitting stakeholder groups, etc). Evaluation: This is not well documented in the PM literature. Ward and Chapman (2003, p. 104) go part-way toward this principle by acknowledging the possibility that some opportunities (and not only threats) arise through stakeholders. One component of opposition is insufficient knowledge by the project team of the product/ process for a particular project. If learning takes place early enough in the project, that learning can be used to improve the project as it progresses. Learning: Be patient and wait for the opposition to make a mistake while taking care to not make any: Many sources of threats are also sources of opportunities.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G25	Urgent moves before big moves; There is no such thing as a small urgent move [Fix weaknesses before starting something new]	Continually-evaluate(player, position): secure OR NOT(secure) When [Play(big(move),elsewhere), secure(position)] When [Play(urgent(move),locally), NOT(secure(position))]	Continually-evaluate ↔ Continually-evaluate player ↔ project-manager position ↔ position secure ↔ secure Play ↔ Make big ↔ significant move ↔ activity elsewhere ↔ new(domain) urgent ↔ urgent locally ↔ local(domain)	Continually-evaluate(project-manager, position): secure OR NOT(secure) When [Make(significant(activity),new(domain)), secure(position)] When [Make(urgent(activity),local(domain)), NOT(secure(position))]

Evaluation	Comments
4	Selection: A Go player is constantly checking the stability of each position. If they are all stable, the player is free to play a big move elsewhere (e.g. in an open area of the board, or an attack on the opponent); if they are not all stable, the player should play a move to defend an insecure position. Mapping: Structure is 1:1; Similarity – a typical <u>big move</u> in Go is to place the first stone in an open area of the board (i.e. <u>elsewhere</u>). This is similar to making a <u>significant activity</u> in a project such as testing the feasibility of a <u>new domain</u> (such as new technology or process), or quickly developing a high-value function for the customer. In Go, an urgent move is one that is played <u>locally</u> to protect a significant investment before it is destroyed by the opposition. In projects, such an urgent activity would similarly be done to protect a <u>local domain</u> (e.g. product / process / stakeholders) before being destroyed by the opposition. Purpose of the principle is the same in both Go and PM. Inferences: A project manager should be constantly checking the stability of each activity. If they are not all stable they should be fixed, otherwise it is possible to initiate another activity. Evaluation: Continual monitoring & evaluation of project status and context is standard project management practice (e.g. Direct and Manage Project Execution, Monitor and Control Project Work processes from (Project Management Institute (2008a)). Fixing minor weaknesses (or fixing them early) is part of the previously mentioned processes. More significant fixes may require Integrated Change Control. But I am not aware of any advice in TPM to increase the level of risk when the situation is secure. Agile allows this principle to be performed in its methodology (primarily though cycle reviews and reprioritizing work each cycle) (Wysocki, 2009). Differences: This is closely related to several other principles, e.g. G07, but this principle (G25) is more concerned about the timing of the fix before losing something significant (urgent) It is also related to G14 – but this principle (G25) is saying to fix significant problems before starting something new. It is also related to G21 – small weaknesses can become urgent to fix if left too long. It is also related to G22 – address high impact & probability threats before adding new risks. G33 and G34 and G47 specify ways to fix an urgent threat. G60 reminds us that sometimes it is appropriate to sacrifice investments if there is another path that has a better chance of achieving the goal Learning: Take the time to fix significant problems. Maintain risk exposure level.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G26	Balance owe and save [Balance risk and safety]	Keep-balance-between(risk, safety)	Keeps-balance-between ↔ Keeps-balance-between risk ↔ risk safety ↔ safety	Keep-balance-between(risk, safety)

Evaluation	Comments
5	Selection: A Go player needs to balance taking risks with playing safe. Too safe and the opponent will win by taking more territory, too risky and the opponent will win by taking more territory (by capturing the player's weak groups). Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Balance risk and safety Evaluation: Hillson (2009) provides a good explanation for explicitly understanding the balance of risk and safety. So does Wildavsky (1988). It is strongly implied in Risk Management in Project Management Institute (2008a). Learning: Balance risk and safety

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G27	Fight to the end; Leave no cannon unspent in battle; Resign when ripe [Resign when there is no way to achieve the goal]	When [resign(player, game), NOT(goal, achievable)]	resign ↔ terminate player ↔ project manager game ↔ project goal ↔ goal not(achievable) ↔ not(achievable)	When [terminate(project-manager, project), NOT(goal, achievable)]

Evaluation	Comments
4	Selection: Knowing when to resign a game is difficult, even for professionals – see Nakayama's essay "The Art of Resigning" in Nakayama (1984). As Nakayama illustrates, one professional might resign if the game will result in a loss by only one point, but another professional might not resign even though losing by over 30 points. Before making a move, especially an invasion into the opponent's area of influence, this principle recommends that a player consider the objective to be achieved and the likely cost (in terms of stones used and the opponent's resulting shape and influence) before making the move. The player should then do everything possible to achieve success, but if that proves to be insufficient, then give up on that battle and look for somewhere else to play. The same process can be applied to the game as a whole. Mapping: Structure is 1:1; Similarity – A Go player will <u>resign</u> when the goal is not achievable. Project managers should similarly <u>terminate</u> projects when they realize the goal is not achievable.; Purpose of the principle is the same in both Go and PM. Inferences: When planning a project, identify the criteria for terminating the project – or even an uncertain activity. Do everything possible to achieve success, but when that proves to be insufficient, then terminate the project or activity. Evaluation: Project governance includes responsibility for terminating projects when appropriate, e.g. (Muller, 2009; Project Management Institute, 2008b). But, "the decision to terminate a project early, by whatever method, is difficult" (Meredith & Mantel, 2006, p. 555) and therefore too infrequently done (Levine, 2005, p. 20). Learning: When planning a project, identify the criteria for terminating the project – and even uncertain activities. Do everything possible to achieve success, but when that proves to be insufficient, then terminate the project or activity.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G28	Play to the biggest area; Corner, side, centre [Choose moves in order by reward-to-risk ratio]	Choose (player, next(move), highest(reward:risk-ratio))	Choose ↔ Choose player ↔ project-manager next(move) ↔ next(activity) reward:risk-ratio ↔ reward:risk-ratio	Choose (project-manager, next(activity), highest(reward:risk-ratio))

Evaluation	Comments
4	Selection: Because Go is a competition between players with the same amount of resources and time, it rewards the one who is most efficient – obtaining the greatest benefit for the number of stones played – from the whole board / global perspective. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Choose as the next activity the one that has the highest reward-to-risk ratio. Evaluation: In a stable environment this is not necessary, e.g. all activities are required to produce the deliverable (100% rule). But in a dynamic context, and where the goal and/or methods are unclear, then producing incremental value is a better way to proceed (Highsmith, 2004; Laufer, 2009; Shenhar, 2008; Wysocki, 2009). Learning: Pick low-hanging fruit early, also check high-risk activities early, too, in case they are not feasible.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G29	Only the right tension is balanced Go; Don't play loose; Don't play too tight [Balance speed of development with stability]	Keep-balance-between(loose, tight)	Keeps-balance-between ↔ Keeps-balance-between loose ↔ loose tight ↔ tight	Keep-balance-between(loose, tight)

Evaluation	Comments
4	Selection: Consider the speed of development vs. stability when choosing a move. I substituted the terms loose and tight for slack and taut which the original author used (T. Anderson, 2004). Other word substitutions might be: Taut: hard, firm, tight, solid, slow, steady; Slack: soft, flexible, loose, open, dynamic, fast; Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Balance the speed of development with stability. E.g. "pick low-hanging fruit" is often prescribed to project managers, but also watch for greater opportunities elsewhere. Understand global needs, understand what is possible locally, consider the relationship of the potential activity with existing products and work, then optimise for the situation. Evaluation: This principle does not make much sense in a stable environment where it is possible to develop and follow a plan with relatively few changes. But it applies to projects in dynamic contexts. It is similar to Agile recommendations for selecting work for a sprint (Schwaber, 2004; Wysocki, 2007). Differences (unmapped): I think *haengma* comes into play with this principle. This is a Korean word that has not been translated into English (nor into Japanese or Chinese), and is a difficult concept for non-Koreans to understand] (S.-R. Kim, 2009; Nam, 2004). Haengma has to do with all of these concepts: speed of development (G29), good shape (G35), connections (G38), relationship between stones (G10), direction of flow (G45, G65, G66), and considering the effect (e.g. resulting shapes) of a move before making it (G10, G41). Learning: Understand global needs, understand what is possible locally, consider the relationship of the potential activity with existing products and work, then optimise for the situation.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G30	Pressing too hard sows the seed for ferocious counterattacks [If the opponent presses too hard, counterattack strongly]	Cause { hard[press(opponent, player(position))], fierce[counterattack(player, opponent(position))]}	hard(press) ↔ hard(press) opponent ↔ opposition player ↔ project position ↔ position fierce(counterattack) ↔ fierce(counterattack) player ↔ project-manager	Cause { hard[press(opposition, project(position))], fierce[counterattack(project-manager, opposition(position))]}
G31	Push, push, push [Press the opponent to prevent achieving the goal]	Push-to-prevent(player, Achieve(opponent, opponent(goal)))	Push-to-prevent ↔ Push-to-prevent player ↔ project manager Achieve ↔ Achieve opponent ↔ opposition goal ↔ goal	Push-to-prevent(project-manager, Achieve(opposition, opposition(goal)))

Evaluation	Comments
4	Selection: If a Go player pushes the opponent too hard, the opponent will likely launch a fierce counterattack. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: If a project manager pushes the opposition too hard, the opposition will likely launch a fierce counterattack. Evaluation: This principle is not to be found in the PMBOK Guide, but is part of managing stakeholders (e.g. Pinto (1996, p. 101)). See also G48. Learning: When pushing the opposition, do so "comfortably" – allow the opposition to become a little uncomfortable, but not so frustrated that they feel the need to pursue extreme measures to counterattack. Do not think in terms of "win : lose", but more like "win : almost-win".
4	Selection: Push to prevent the opponent from achieving its goal. E.g., This is White's strategy in the opening of a game of Go. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Push the opposition to prevent it from achieving its goal. Evaluation: This principle assumes an active, strongly negative opposition. Pinto (1996, pp. 84-85) mentions deception and divide-and-conquer as a couple of political tools. This principle is implied in change management / stakeholder mgmt (e.g. Daniel (2007) and Hiatt (2006)). Related to G32. Learning: Keep pressure on opposition so it cannot achieve its goal – distract it from preventing the project team from achieving the project goal.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G32	Push, push, push [Push the opponent to achieve the project goal]	Cause[constantly-push(player, opponent), achieve(player, goal)]	constantly-push ↔ constantly-push player ↔ project manager opponent ↔ opposition achieve ↔ achieve player ↔ project goal ↔ goal	Cause[constantly-push(project-manager, opposition), achieve(project, goal)]
G33	Attack from a distance; Don't touch the invader – part of ma-ai [Attack the opponent indirectly]	Cause[Distant-from(move, opponent(position)), attack(player, opponent(position))]	Distant-from ↔ Distant-from move ↔ activity opponent ↔ opposition position ↔ position attack ↔ attack player ↔ project-manager	Cause[Distant-from(activity, opposition(position)), attack(project-manager, opposition(position))]

Evaluation	Comments
4	Selection: A Go player pushes the opponent in order to achieve the goal. Mapping: Structure is 1:1 but not isomorphic; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Push the opposition in order to achieve the project goal. Evaluation: This principle assumes an active, strongly negative opposition. Pinto (1996, pp. 84-85) mentions deception and divide-and-conquer as a couple of political tools. This principle is implied in change management / stakeholder mgmt (e.g. Daniel (2007) and Hiatt (2006)). Related to G31. Learning: Keep pressure on opposition so the project team can perform the more important / more strategic activities, and achieve the project goal.
3	Selection: Do not attack the opponent's strengths directly: build new strengths to use to attack later (e.g. build a base from which to attack or to run toward from a deep invasion into the opponent's area of influence). "an attacking move must be severe; it must hit the enemy where it hurts. Severity is the heart of the matter, while being a non-contact move is more a surface issue" (A. Ishida & Davies, 1980, p. 61). Mapping: Structure is 1:1; Similarity – see previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Do not attack the opposition's strengths directly: build new strengths to use to attack later (e.g. build a base from which to attack or to run toward from a deep invasion into the opposition's area of influence). Evaluation: This principle assumes a strong, negative opposition. This is one aspect of deception that Pinto (1996) mentioned, and the 36 Strategems applied to the game of Go in Ma (2000) is full of. It is closely related to G34. "Flow" (see G29) derives partly from maintaining proper distance between all others (also related to "see the interconnections" (G10)). Following this principle also helps to follow G12. Following this principle also helps to prevent giving away too much information about intentions, which could give the opposition an advantage (G20 and G51). This goes against traditional PM practice, e.g. (Magenau & Pinto, 2004, p. 1045). Ma-ai refers to keeping a proper distance, from friends and foes, which depends on the circumstances. Differences (unmapped): This "how-to" follows from G31 & G32. Learning: Do not attack the opposition's strengths directly; build new strengths to use to attack later.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G34	Defend up close – part of ma-ai [Play close to the opponent when defending]	Cause[close-to(move, opponent(position)), defend(player,player(position))]	Close-to ↔ Close-to move ↔ activity opponent ↔ opposition position ↔ position attack ↔ attack player ↔ project-manager player ↔ project	Cause[close-to(activity, opponent(position)), defend(project-manager,project(position))]

Evaluation	Comments
3	Selection: In the game of Go, when in a life-and-death situation or if ahead, it's okay for a player to directly attack the opposition's strengths (e.g. both sides gain strength), as long as a solid position is built. (Yang, 2002, p. 194). Once a position is solid (even if small), then a player can take the offensive without worrying about attacks against that position. Territory can be made elsewhere, or a player can destroy some of the opponent's territory (i.e. by taking advantage of opportunities, "striking while the iron is hot" (G17)). Also, by making a small but solid position, a player reduces the information available to the opposition, increasing the level of uncertainty for the opponent (G20 and G51) – related to G76 and G80). A "how-to" that follows from G31 & G32. Related to G33. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: When defending a project position, it's okay to also strengthen a similar opposition's position. Evaluation: This principle assumes a strong, negative opposition. Differences (unmapped): Ma-ai refers to keeping a proper distance, from friends and foes, which depends on the circumstances. Learning: Make solid, stable positions – even strengthening the opposition if necessary – in order to take advantage of opportunities elsewhere later.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G35	Make Good shape – part of ma-ai [Play moves that increase strength, flexibility and resilience]	Choose(player, next(move), good(shape)) AND[strong(position), flexible(position), resilient(position)] : good(shape)	Choose ↔ Choose player ↔ project-manager next(move) ↔ next(activity) good(shape) ↔ good(shape) strong ↔ strong flexible ↔ flexible resilient ↔ resilient position ↔ position	Choose(project-manager, next(activity), good(shape)) AND[strong(position), flexible(position), resilient(position)] : good(shape)
G36	Timing is everything; Order is everything [Time moves to align with current priority and goal]	Cause[correct-timing(player, move), achieve(player, goal)]	Correct-timing ↔ Correct-timing player ↔ project-manager move ↔ activity achieve ↔ achieve player ↔ project goal ↔ goal	Cause[correct-timing(project-manager, activity), achieve(project, goal)]

Evaluation	Comments
2 (4)	Selection: In the game of Go, a move makes good shape when it is an appropriate distance from other stones, and works with other stones to be strong, flexible and resilient. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Choose activities that make good shape, i.e. that have an appropriate separation from other activities, and works with them to be strong, flexible and resilient. Evaluation: This principle assumes a dynamic context. Agile methods allow / encourage this principle throughout a project. E.g. Wysocki (2007, pp. 409-411) recommends using high-risk, high-complexity, short-duration, high-business value, and order of dependencies as criteria for prioritizing next activities. The considerations for good shape in Go are a good start but may not be sufficient for projects. Learning: In dynamic situations, choose activities that have an appropriate separation from other activities and work with them to be strong, flexible and resilient.
4	Selection: In the game of Go the timing of a move is important – delay too long and the opportunity may be gone, but play it too early and its full potential may not be realized. See G76 for an illustration of an aspect of good timing. G32-G25 deal with some other aspects. Mapping: Structure is 1:1; Similarity – see previous comments; Purpose of the principle is the same in both Go and PM. Inferences: In a dynamic situation, priorities change as the context changes, so the timing of an activity needs to align not only with the goal (G01) but also with the current priority (G16). Evaluation: G35 comments also apply here. Learning: In dynamic situations a project manager must be strategic in determining the next sequence of activities – perform them in the sequence most likely to obtain the objective and least susceptible to obstruction. This will likely not be the same order of tasks as in a stable situation.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G37	Don't throw good stones after bad [Each move is a lost opportunity to do something else]	Lost (each(move), opportunity)	Lost ↔ Lost each(move) ↔ each(activity) opportunity ↔ opportunity	Lost (each(activity), opportunity)
G38	Don't give up key stones; Give up superfluous stones[Split the opponent into weak groups]	Cause[Separate(opponent (group), opponent(group)), opponent(weak(p osition))]	Separate ↔ Separate opponent ↔ opposition group ↔ group weak ↔ weak position ↔ position	Cause[Separate(oppositio n(group), opposition(group)), opposition(weak(p osition))]

Evaluation	Comments
4	Selection: Each placement of a stone eliminates all the other opportunities that were available on that move. In choosing a move, a player claims that it is the best of the 200 (approximate average) other options – and their continuations - available. Do not waste it. Implied by G16. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Each activity undertaken is a lost opportunity to do something else. Do not waste it. Evaluation: in stable environments this principle is not very helpful, but in dynamic situations it is, and is included in Agile methodologies in choosing items from the Scope Bank for each sprint (Schwaber, 2004). It is also incorporated in decision-making processes (e.g. a decision is a choice between alternatives (Hammond et al., 1999)). Differences (unmapped): competent decision-making is required of go-players. Learning: There is an opportunity cost associated with each activity – the lost opportunity of doing something else. At the portfolio level, each project is an investment, so doing one project involves an opportunity cost of not doing something else. Do not waste it.
4	Selection: In the game of Go, one way that a player can weaken the opponent is to split an opponent's group into two by cutting across a potential connection. If this action creates two weak opponent groups, then the player can attack them, taking profit while doing so. If both opponent groups live, then the cutting stones become superfluous. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Weaken a strongly negative opposition by splitting it into smaller, weaker groups. Try to prevent it happening to the project. Evaluation: "Divide and conquer" is mentioned in Pinto (1996). The DSM method incorporates this principle (Daniel, 2007). Learning: When there is strong negative opposition, it might help the project to divide the opposition into smaller and hopefully weaker groups ("Divide and conquer"). Also be watchful that the opposition does not do the same to the project (i.e. stay connected).

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G39	Take your profit before leaving [Produce value before considering the situation "done"]	When{ increase(player, points), leave(player, local(situation)) }	Increase ↔ Increase player ↔ project value ↔ value leave ↔ leave player ↔ project-team local(situation) ↔ local(situation	When{ increase(project, value), leave(project-team, local(situation)) }
G40	Until you can unlearn what you have learned, you cannot see [To gain a deeper understanding of a concept, unlearn what has already been learned]	When{ Allow[Unlearn(player, current-level (knowledge)), Gain(player, deeper-level (knowledge)], Mastered(player, current-level (knowledge)) }	Allow ↔ Allow Unlearn ↔ Unlearn player ↔ project-manager knowledge ↔ knowledge Gain ↔ Gain deeper-level ↔ deeper-level Mastered ↔ Mastered current-level ↔ current-level	When{ Allow[Unlearn(project-manager, current-level(knowledge)), Gain(project-manager, deeper-level(knowledge)], Mastered(project-manager, current-level(knowledge))}

Evaluation	Comments
4	Selection: Before leaving a local situation, take some territory (G39), or create uncertainty (G80). Weaker players have a hard time recognizing when to leave a local situation (G27), and suffer for it later. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Make sure to produce value before considering an activity "done". Evaluation: This principle assumes a dynamic context. Agile methods explicitly incorporate this principle. E.g., D. Anderson et al. (2005), Beck et al. (2001), Highsmith (2004), and Schwaber (2004). Consequences: This principle may appear to contradict G14 (play flexible moves), but really does not. This principle (G39) say to get some profit – but combined with G14 implies not to try to get the maximum possible – because that would be playing too loose (G29), and the group would likely come under attack, allowing the opponent to get ahead. Learning: Ensure to get some profit when negotiating; deliver value whenever possible.
4	Selection: Once a player has mastered a concept, some of what has been learned must be unlearned in order to gain a deeper understanding. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Once a project manager has mastered a concept, some of what has been learned must be unlearned in order to gain a deeper understanding. Evaluation: Unlearning is not usually part of the PM literature e.g., Laufer (2003), but is part of general management literature, e.g. Hamel and Prahalad (1994), H. Dreyfus and Dreyfus (2005), and Senge (1990). Closely related to G53. Learning: For a novice to learn project management, the information needs to be simplified into basic rules. When the rules have been mastered, then it is time for the project manager to go to the next level of understanding, which requires unlearning what has already been learned in order to understand more deeply.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G41	Read, read, read [Practice reading to increase reading competence]	Cause { Cause [Practise(player,reading), Increase(player, reading (competence)] : a AND [Improves(a, efficiency), Provides(a, heuristics-for- better-play), Identifies(a, potential-threats), Identifies(a, potential-opportunities)] }	Practise ↔ Practise player ↔ project-manager reading ↔ planning competence ↔ competence Improves ↔ Improves efficiency ↔ efficiency Provides ↔ Provides heuristics-for-better-play ↔ heuristics-for-better-work Identifies ↔ Prepare-for potential-threats ↔ potential-threats Identifies(potential-opportunities) ↔ Identifies (potential-opportunities)	Cause { Cause [Practise(project-manager, planning), Increase(project-manager, planning-competence)]: a AND [Improves(a, efficiency) Provides(a, heuristics-for- better-work) Identifies(a, potential- threats) Identifies(a, Potential-opportunities)] }

Evaluation	Comments
4	Selection: Practicing reading improves a Go player's reading ability. Becoming fast and accurate at reading straightforward situations: 1. Allows a player time to research more possibilities to find a good move 2. Gives a player heuristics for what to look for in a new situation 3. Allows a player to identify and prepare for potential threats 4. Allows a player to see a weakness in the opponent's position that the opponent may not yet be aware of – and take advantage of it. In the game of Go, this planning occurs almost every move. Mapping: Structure is 1:1; Similarity – Reading, to a Go player, means playing out in their head the likely sequence of moves that would follow from a particular move – for both players. It usually also implies looking at a number of alternative sequences, and also a number of alternative initial moves. This is exactly the same process that project teams use for planning a project. Heuristics for better play refers to the guidelines that a player uses to cut down the number of potential alternatives to a few for serious consideration. In the same way, a project team uses heuristics for better work to reduce the number of potential alternatives they consider when planning work. Note that reading/ planning identifies potential threats and opportunities – because a decision has not yet been made whether to follow any particular path; Purpose of the principle is the same in both Go and PM. Inferences: Practicing reading improves a Go player's reading ability. This means a player improves the efficiency of play by learning to recognize and choosing not to play inefficient moves and by improving the heuristics used for finding good moves, which together reduces the time it takes to find a good move; to identify and protect against potential threats; and to identify and take advantage of potential opportunities. This principle promotes gaining lots of experience in a particular area of expertise, but sufficiently broad to anticipate likely eventualities in future. So this principle recommends bringing in people who are experts in the field of the project to help with the planning. Evaluation: "Practise makes perfect". But doing the same type of thing over and over again does not build broad competence as much as learning in new situations (ICB3 p.7). In Agile, planning adjusts for recent learning at the beginning of each sprint, e.g. (Wysocki, 2009), (Schwaber, 2004). In more stable contexts it occurs at the beginning of a project and then as a result of a change request (Project Management Institute, 2008a) Consequences: Some of the benefits of practise are listed - but this is not a complete set for either Go or PM. Adaptation: Replace the Go term reading with planning keep its meaning. Learning: Projects in dynamic, uncertain environments need to be planned broadly, deeply and iteratively.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G42	Player's strength is largely determined by the ability to read. [Practice reading to increase playing competence]	Cause[increase(player, reading(competence)), increase(player, playing(competence))]	Increase ↔ Increase player ↔ project-manager reading ↔ planning competence ↔ competence playing ↔ managing	Cause[increase(project-manager, planning(competence)), increase(project-manager, managing(competence))]

Evaluation	Comments
5	Selection: Being able to read well allows a Go player to do things well. Mapping: Structure is 1:1; Similarity – See previous comments, A Go player's <u>playing competence</u> increases as reading competence improves, although that is not the only or even most important factor in playing success. Similarly a project manager's <u>managing competence</u> increases as planning competence improves, although that is not the only or may not even be the most important factor in project management success.; Purpose of the principle is the same in both Go and PM. Inferences: Being able to plan well allows a project manager to do things right (cf. Dinsmore & Cooke-Davies (2006)). Evaluation: There is support for this principle in the PM literature (e.g. the Planning process group in Project Management Institute (2008a); Quality of planning is key for achieving project success (Dvir & Lechler, 2004, p. 10), but there are also contradictory reports, e.g. "successful projects are those in which the 'people side' has been well managed" (Slevin & Pinto, 2004, p. 83). These two articles had different objectives, which may explain their different conclusions. Learning: Planning is a vital skill for a project manager

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G43	Don't try to read too much, but play more games instead [Increase reading competence by increasing playing competence]	Cause[increase(player, playing(competence)), increase(player, reading(competence))]	Increase ↔ Increase player ↔ project-manager reading ↔ planning competence ↔ competence playing ↔ managing	Cause[increase(project-manager, managing(competence)), increase(project-manager, planning(competence))]
G44	In Go, the trial is not too costly – you can learn a lot and fail all you want. [Take risks, fail, and learn from those failures]	Cause (Cause { Cause [Failure, NOT(serious (consequences)], Take(player, risks) } Learn-from(player, failure))	Failure ↔ Failure serious(consequences) ↔ serious(consequences) Take ↔ Take player ↔ project-manager risks ↔ risks Learn-from ↔ Learn-from	Cause (Cause { Cause [Failure, NOT(serious (consequences)], Take(project-manager, risks) } Learn-from(project-manager, failure))

Evaluation	Comments
4	Selection: Learn by doing, then reviewing and fixing. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Learn by doing, then reviewing and fixing. Evaluation: This principle is supported in the PM literature, e.g. (J. R. Turner, Keegan, & Crawford, 2000). Many project managers take on the role directly from being a senior technical person, only afterward realizing that they had been doing project management all along (Paton, Hodgson, & Cicmil, 2010), therefore getting some experience prior to taking on the title of 'project manager'. Agile projects provide a project manager with even more practice. E.g. an Agile project with 3 cycles is like managing 4 projects: the overall project, plus each of the cycles is like a complete project in itself. Consequences: This principle (G43), along with the previous one (G42) show that learning is iterative – a feedback cycle that grows between planning and doing and planning and doing… This is the Go player's version of Deming's (or Shewhart's) Quality Cycle (Plan – Do – Check - Act). A person gains experience and competence from making mistakes and reflecting on them, especially with the help of a teacher (G58). Learning: Learn by doing, then reviewing and fixing. Project managers need to practice planning, e.g. using cases such as Anbari et al. (2005); Anbari, Giammalvo, Jaffe, Letavec, and Merchant (2005), Anbari et al. (2006), Cleland, Bursic, Puerzer, and Vlasak (1998), Kerzner (2009a), and Morris and Hough (1987).
1	Selection: A Go player learns from failure because the consequences are not serious. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager learns from failure because the consequences are not serious. Evaluation: There are often serious consequences of failure on projects, so significant risk-taking is usually neither appropriate nor condoned. But, the riskiness of not making changes or taking risks is often ignored (Wildavsky, 1988). Learning: Use the game of Go as a safe place to learn risk-taking and decision-making skills.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G45	Tewari [Analyze different sequences of activities to find the best one]	Cause[Analyse(player, different- sequence(moves)), Find(player, moves, best (sequence))]	player ↔ project-manager different-sequence ↔ different-sequence moves ↔ activities best-sequence ↔ best-sequence	Cause[Analyse(project-manager, different-sequence(activities)), Find(project-manager, activities, best(sequence))]
G46	Balance planning forward and planning in reverse	Keep-balance-between((forward) planning, (backward)planning)	Keep-balance-between ↔ Keep-balance-between forward ↔ forward planning ↔ planning backward ↔ backward	Keep-balance-between((forward) planning, (backward)planning)

Evaluation	Comments
5	Selection: Go players try to find the best sequence of moves to achieve a specific objective. Any inefficiency gives the opponent an opportunity to get ahead. Tewari can be done after the fact, e.g. when reviewing a game after it is over, or during a game when trying to decide on a course of action. In the former situation, moves are analyzed to find inefficiencies to prevent similar inefficiencies in future. When performed during a game, fewer alternatives can be analyzed due to time constraints. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: In dynamic situations, project managers should analyze different sequences of activities to find the best sequence to achieve an objective. Evaluation: The PM literature includes this principle when discussing activity scheduling and especially schedule compression, e.g. (Meredith & Mantel, 2009; Project Management Institute, 2008a; Wysocki, 2009). The Optimization school and Koskela via his Flow view, e.g. Koskela (2000), Koskela and Howell (2002b), recommend reducing waste. Several authors suggest building the schedule from back to front, e.g. (Kyle, 1998; Wysocki, 2009). Learning: When planning (and replanning – whether due to Change Control, Issues, or part of each new Cycle Plan in Agile methods), the project manager should try analyzing the sequence of activities to find and eliminate inefficiencies (and possibly new insights) to find the best sequence.
4	Selection: Go players plan forward to find a way to achieve the goal or objective, then plan backward from the goal or objective to find the best way forward. Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Plan forward to find a way to achieve the goal or objective, then plan backward from the goal or objective to find the best way forward. Evaluation: Planning forward is the standard method, e.g. (Project Management Institute, 2008a); only a few promote planning backward, e.g. Kyle (1998), Daniel (2007), and Wysocki (2009). Learning: Plan forward to find a way to achieve the goal or objective, then plan backward from the goal or objective to find the best way forward.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates

G47	To defend, attack; [Defend a weakness by attacking an opponent's weakness]	When{
		 Cause[
		 Find(player, move,
		 AND {
		 attack(opponent(position)),
		 defend(player(position)) })],
		 player(weak(position)) }
			player ↔ project-manager
			 move ↔ activities
			 attack ↔ attack
			 defend ↔ defend
			 opponent ↔ opposition
			 player ↔ project
			 weak ↔ weak
			 position ↔ position
				When{
				 Cause[
				 Find(project-manager, activities,
				 AND {
				 attack(opposition(position)),
				 defend(project(position)) })],
				 project(weak(position)) }

Evaluation	Comments
3	Selection: In the game of Go, protecting a weak group(s) by attacking opponent's weakness is standard practise (at least with good players). "I need to defend, but the opponent needs to defend more". This principle follows from at least the following principles: do a SWOT analysis (G03), analyze the situation and trajectory (G65), see the interconnections (G10), take the initiative (G61), weak positions become weaker (G21), urgent before big (G25), prevent opponent from achieving that goal (G31), push opponent to achieve project goal (G32), timing is everything (G36), read, read, read (G41), keep balance between player and opponent (G54), opponent's best move is your best move (G55), be objective (G64), play multi-purpose moves (G73), do not resolve uncertainty before its time (G76), make the situation unclear for the opponent (G80), and know your goal (G83). Mapping: Structure is 1:1 but not isomorphic; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Protect a weakness by attacking a weakness of the opposition. Evaluation: Defend by attacking is a common human response (e.g. "amygdala hijack" is the term used for this, from Goleman (1995)). Good practice in projects is to simply fix the problem (Gido & Clements, 2006, p. 85). But in a highly competitive situation, or with strong, active negative opposition, it might be too slow – in which case the project may need to destroy or seriously weaken some opposition's position(s) to maintain a possibility of reaching the goal. Another interpretation and use for the sub-principle principle "attack the opposition" is to look for the root cause of problems. Learning: Take the time to review the situation before "automatically" responding with what intuitively seems the right thing to do.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G48	Don't attack to kill, attack to gain a small profit [Produce profit when attacking the opponent]	Cause{ Attack(opponent(position)), Find(player, move, increase (points)) }	Attack ↔ Attack opponent ↔ opposition position ↔ position player ↔ project-manager move ↔ activity increase ↔ increase points ↔ value	Cause{ Attack(opposition(position)), Find(project-manager, activity, increase(value)] }

Evaluation	Comments
5	Selection: Attack the opponent in a way that increases territory. Mapping: Structure is 1:1; Similarity – A Go-player wants to increase points to reach the goal, a project manager wants to increase value to reach the goal. Also see previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Attack the opposition in a way that increases value. Evaluation: This principle recommends finding a "win-win" solution (but with the player gaining a little bit more than the opposition) – rather than choosing a "win-lose" alternative. The latter often turns out badly for the aggressor (Fisher, Ury, & Patton, 1991). Negotiation in general is only included in an appendix in Project Management Institute (2008a), although it is incorporated into Caupin et al. (2006). Differences (unmapped): Related to G30 Learning: When planning to attack the opposition, ensure it produces value.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G49	Always know the score	Always-knows(player, AND(player(points), opponent(points)))	Always-knows ↔ Always-knows player ↔ project-manager AND(player(points) opponent(points)) ↔ project-status	Always-knows(project-manager, project-status)

Evaluation	Comments
5	Selection: A Go player should always know how far is ahead or behind the opponent is. This will affect the style of play. Mapping: Structure is not quite 1:1; Similarity – In the game of Go, a player wins by having more points that the opponent, so the score is the difference between the <u>player's points</u> and the <u>opponent's points</u>. The status of the game at any time is based on an estimate of the score. In projects, the <u>project status</u> is the likelihood of achieving the project goal within the project constraints. This is often estimated using Earned Value Analysis.; Purpose of the principle is the same in both Go and PM. Inferences: A project manager should always know whether the project is ahead or behind, and by how much. This will affect how the planning of future activities. Evaluation: A project manager monitors and controls project work (Project Management Institute, 2008a). One of the tools is Earned Value Management. The concept of Earned Value is similar in PM and in the game of Go, but the vocabulary is different. Knowing the project status is necessary to know whether alternative actions are required to achieve the goal. Ideally the information should be real-time, but since that is impossible in most organizations, try to minimize the delay between actions and reporting of actions, so that corrective action, if necessary, can be implemented as soon as possible. e.g. see Dinsmore and Cooke-Davies (2006). Differences: G22 (Adjust risk according to the score) depends on this principle. Learning: Always know the status of the project in order to know how to act.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G50	When you make a mistake, thereby creating Slack on the board, if the opponent does not take it up, the potential for 120 percent correct moves exist. [A players mistakes can be a source of opportunities]	Make(player, bad(move)) : mistake NOT(take-advantage-of)(opponent, mistake) : 2nd-mistake Cause[take-advantage-of(player, 2nd- mistake), increase(player, points))]	Make ↔ Make player ↔ project-manager bad ↔ bad move ↔ plan take-advantage-of ↔ take-advantage-of opponent-opposition increase ↔ increase player ↔ project points ↔ value	Make(project-manager, bad(plan)) : mistake NOT(take-advantage-of)(opposition, mistake) : 2nd-mistake Cause[take-advantage-of(project- manager, 2nd-mistake), increase(project, value))]
G51	Seeing through your opponent's eyes [Understand opponent's intentions to make better plans]	Cause[understand(player, opponent (intentions)), make(player, plans)]	Understand ↔ Understand player - ↔ project-manager opponent ↔ opposition intentions ↔ intentions make ↔ make plans ↔ plans	Cause[understand(project-manager, opposition(intentions)), make(project-manager, plans)]

Evaluation	Comments
1	Selection: A player's mistakes can be a source of opportunities is the opponent does not take advantage of them first. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager's mistakes can be a source of opportunities if the opposition does not take advantage of them quickly and the project manager realizes the mistake and finds a way to capitalize on it. Evaluation: I am not aware of any support for this principle in the PM literature. I am not even sure that it applies to PM. In the game of Go, a player's mistakes can become good moves if the opponent does not take advantage of them, and the player does. Some Go players intentionally play this way (making overplays), especially against weaker players. If their opponent lets them get away with it, the player gets ahead. But if the opponent responds effectively, the player falls behind – so it is high-risk strategy. Learning: Mistakes can be a source of opportunities.
5	Selection: Understanding the opponent's intentions allows a player to make better plans. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Understanding the opposition's intentions allows a project manager to make better plans. Evaluation: This principle is included in stakeholder management, and well represented in PM literature, e.g. Caupin et al. (2006), Project Management Institute (2008a). Differences (unmapped): This principle is closely related to G20, and also G45 and G46. Understanding the opponent's intentions, a player can plan backward or in different sequences to find an efficient way to disrupt those intentions and also build toward the player's goal (G01, G02, G04) – when planning an attack on the opposition. This would be a multipurpose move (G73). Learning: Understanding the opposition's intentions allows a project manager to make better plans.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G52	Build and have confidence in your own ability	Build-and-have(player, AND(ability, confidence)	Build-and-have ↔ Build-and-have player ↔ project-manager ability ↔ ability confidence ↔ confidence	Build-and-have(project-manager, AND(ability, confidence)

Evaluation	Comments
5	Selection: Go players needs to develop their abilities, and also be confident in using them. “the astonishing amount of confidence a professional has in himself” (Kageyama, 1978), p.39. “It all comes down to self-confidence. You win, so you gain confidence in your own style. If you have self-confidence, you win all the more.” (Kato, Rin, Ishida, & Kobayashi, 1986). Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Project managers need to develop their abilities, and also be confident in using them. Evaluation: This principle is similar in both Go and PM, e.g. Cleland and Ireland (2010, p. 204); Meredith and Mantel (2009, p. 119); Archibald (2003a, p. 99). Differences: Some of the abilities are different between a project manager and a Go player, but the principle as it stands applies to both. Learning: Project managers need to develop their abilities, and be confident in using them.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G53	SHU, HA, RI [To advance in a field, first learn the basics, then confront your comfort zones, and then develop your unique approach]	Cause{ Learn(Player, basics): Shu, Challenge-after-Shu(player, comfort-zones): Ha, Develop-after-Ha(player, unique(approach)) : Ri}	Learn ↔ Learn player ↔ project-manager basics ↔ basics Challenge-after-Shu ↔ Challenge-after-Shu comfort-zones ↔ comfort-zones Develop-after-Ha ↔ Develop-after-Ha unique(approach) ↔ unique(approach)	Cause{ Learn(Project-manager, basics): Shu, Challenge-after-Shu(project- manager,comfort-zones): Ha, Develop-after-Ha(project- manager, unique(approach)) : Ri}

Evaluation	Comments
4	Selection: A Go player starts by learning the basics, becoming comfortable with particular aspects. Then a player learns different techniques until those become strengths. Eventually a player can put together the various techniques that have been learned plus new developments of one's own to create a unique style based on that particular combination of values, beliefs, knowledge, abilities, etc. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager starts by learning the basics, becoming comfortable with particular aspects. Then a project manager learns different techniques until those become strengths. Eventually a project manager puts together the various techniques learned and developed to create a unique style based on that particular combination of values, beliefs, knowledge, abilities, etc. Evaluation: This is very similar to the five-stage model of adult skill acquisition of S. Dreyfus (2004), referred to in Dinsmore and Cooke-Davies (2006, p. 252). Learning after the basics requires unlearning previous simplifications. Laufer (2009) references Argyris and Schon (1978) regarding double-loop learning, and Hamel and Prahalad (1994) regarding an "unlearning" organization. This is partially formalized in PM in terms of career paths. Project managers typically start with managing a small portion of a larger project, then managing small projects, and up to managing large projects (e.g. Meredith and Mantel (2009, p. 114). IPMA's 4-level competence certification system assumes a career path for PMs. (Caupin et al., 2006, p. 3). Differences (unmapped): This is another type of learning cycle (see also G40 and G43) referring to concepts (or groups of concepts). Learning: To advance in a field, first learn the basics, then confront your comfort zones, and then develop your unique approach

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G54	Keep balance between player and opponent	Keep-balance-between(player, opponent)	Keeps-balance-between ↔ Keeps-balance-between player ↔ stakeholders opponent ↔ opposition	Keep-balance-between(stakeholders, opposition)

Evaluation	Comments
5	Selection: A Go player wants to maintain balance with the opponent. Balance does not mean playing the same style as the opponent, or keeping the score identical, or making a mistake if the opponent does, but to prevent the opponent from getting out of the player's control. This can be especially difficult with some of each player's stones inside the other's potential territory. Of course, if a player can get ahead, then do so and maintain the lead. Mapping: Structure is 1:1; Similarity – In the game of Go, there are only two participants, so the player needs to maintain balance with the opponent. But in projects there are many more people involved, so in this research supportive stakeholders are considered similar to the Go player, and are to be balanced with the project opposition. Keeping balance in this situation does not mean having the same number of people, nor necessarily of having the same amount of power, but maintaining an appropriate distance and attitude of respect; Purpose of the principle is the same in both Go and PM. Inferences: Maintain balance between positive stakeholders and the opposition. Of course, if the project can get ahead, it should do so. Evaluation: This is standard stakeholder management practice (e.g. Hiatt & Creasey (2003). This should be done continuously throughout a project (e.g. Cleland and Ireland (2007, p. 150), doing continuous environmental scans to detect changes in stakeholder support (Bredillet, 2008d; Daniel, 2007). Opposition is not only negative stakeholders, but all sources of threats to a project. At the beginning of a project all is in balance – there are no opportunities (which would imply weaknesses in planning). As time passes threats and opportunities are presented. Responding only to threats is unbalanced – the opposition will take advantage of opportunities as well. Take advantage of opportunities (G17). If project status is currently in your favour, then maintain that balance. Learning: Maintain balance between positive stakeholders and the opposition, and continuously monitor them. Of course, if the project can get ahead, it should do so.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G55	Your opponent's best move is your best move	Same[best(player,move), best(opponent, move)]	Same ↔ Same player ↔ project move ↔ activity best ↔ best opponent ↔ opposition	Same[best(project,activity), best(opposition, activity)]

Evaluation	Comments
3	Selection: In a game of Go, both players have the same goal, and compete to achieve it. Often the best move for one player is the same as for the opponent. If the opponent misses the best move, then the player gains a slight advantage (G24). Mapping: Structure is 1:1; Similarity – see previous comments; Purpose of the principle is the same in both Go and PM. Inferences: The best way for the opposition to thwart the project is often the best way for moving the project toward the goal. Evaluation: In organizational change projects, executive sponsorship is the most critical success factor (Creasey & Hiatt, 2009). Poor sponsorship is the reason that some projects fail or do not even begin - because influential opposition plays the game of business / politics better than project managers and sponsors. (Dinsmore & Cooke-Davies, 2006; Wysocki, 2009). Learning: When planning a project, consider the most efficient way forward (traditional thinking), and also preventive measures to mitigate the most likely threats (e.g. "what's the worst thing that could happen?"). Become adept at using power, influence and negotiation. (Magenau & Pinto, 2004; Pinto, 1996)

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G56	Go, when it is management by committee, is certainly three stones weaker. [Members of teams need to communicate and coordinate]	When{ needs(team, AND(communication, coordination)) , Consists-of(team, multiple (players)) }	Needs ↔ Needs team ↔ team communication ↔ communication coordination ↔ coordination consists-of ↔ consists-of multiple ↔ multiple players ↔ members	When{ needs(team, AND(communication, coordination)) , Consists-of(team, multiple (members)) }

Evaluation	Comments
5	Selection: Members of teams need to communicate and coordinate. The formal rules of Pair Go prevent the players from communicating: "During the game, partners must not communicate, give advice, or exchange other information by speech, gestures, mannerisms, or any other means except playing moves. Speaking is permitted, however, to confirm whose turn it is to play, or confer about resigning. Conferring about resigning is limited to the following: the player to move may ask for his or her partner's consent to resign; the partner may agree or not agree to resign." [14] This is a serious handicap, therefore these games, although competitive, are not of the same calibre as regular Go games, even between the same players. There have been occasional non-tournament games when teams play "consulting games" – where the partners on a team can discuss their options before playing a move. One example is documented in Fairbairn and Hall (2009), which shows a very high-quality game. Mapping: Structure is 1:1; Similarity – Go can be played by two or more players on a team (i.e. Pair Go or Rengo). In projects, the project team consists of members with appropriate knowledge, skills, and abilities to produce the goal of the project; Purpose of the principle is the same in both Go and PM. Inferences: Members of teams need to communicate and coordinate. Evaluation: Having more than one person on a project demands intensive communication to ensure transparency, shared learning, etc. (Caupin et al., 2006; Laufer, 2009; Project Management Institute, 2008a). The need is even higher for projects in dynamic contexts (Ambler, 2004). Learning: Members of teams need to communicate and coordinate.

[14] http://www.pairgo.or.jp/setumei/rule.htm

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G57	Your opponent often helps you more than you could yourself. [Play strong opponents to increase competence]	Cause[plays(player, strong (opponent)), improve(player, competence)]	Plays ↔ Faces player ↔ project-manager strong ↔ strong opponent ↔ opposition improve ↔ improve competence ↔ competence	Cause[faces(project-manager, strong (opposition)), improve(project-manager, competence)]
G58	Listen to your teacher to increase competence)	Cause[follow-instructions(player, master), improve(player, competence)]	Follow-instructions ↔ Follow-instructions player ↔ project-manager master ↔ mentor improve ↔ improve competence ↔ competence	Cause[follow-instructions(project-manager, mentor), improve(project-manager, competence)]

Evaluation	Comments
4	Selection: Striving to overcome a strong opponent pushes a player to improve over time. Welcome the opportunity. Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Striving to overcome many challenges in a project helps a project manager to improve over time. Enjoy the challenge. Evaluation: Adversity is necessary for growth (S. Dreyfus, 2004; Laufer & Hoffman, 2000). See also G43 and G53 Learning: Adversity is necessary for growth. Welcome opposition. Do your best!
4	Selection: Go players improves by listening to their master. Mapping: Structure is 1:1; Similarity – In Oriental traditions, a person learns from a master – "a skilled workman, or craftsman, qualified to teach apprentices"[15] And in Western society we often refer to such a person as a mentor – "a wise and trusted advisor"[16]; Purpose of the principle is the same in both Go and PM. Inferences: Project managers improve by listening to their mentor. Evaluation: Mentors / teachers help people to improve their competence (S. Dreyfus, 2004). Mentors can often see weaknesses in a person that they cannot see in themselves. PM is not on typical career paths to top management positions: "With a very few notable exceptions, we know of no specific career paths that can take project managers to CEO positions" (Meredith & Mantel, 2009, p. 113). Learning: In order to improve, a project manager should find a mentor.

[15] Master. Gage Canadian Dictionary (1983). Toronto, ON: Gage Educational Publishing Co.

[16] Mentor, Gage Canadian Dictionary (1983). Toronto, ON: Gage Educational Publishing Co.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G59	Don't be attached to your stones; Give up superfluous stones; Once stones have carried out their mission, give them up [Sacrifice some stones for a better chance to win]	When{ sacrifice(player, group-of-stones), has-bigger-impact-on(other(move), goal)}	Sacrifice ↔ Sacrifice player ↔ project-manager group-of-stones ↔ deliverables has-bigger-impact-on ↔ has-bigger-impact-on other ↔ other move ↔ activity goal ↔ goal	When{ sacrifice(project-manager, deliverables), has-bigger-impact-on(other(activities), goal)}
G60	Clarity of objective is essential for knowing what to sacrifice.	When{ sacrifice(player, group-of-stones) has(player, clear(objective)) }	Sacrifice ↔ Sacrifice player ↔ project-manager group-of-stones ↔ deliverables clear ↔ clear objective ↔ objective	When{ Sacrifice(project-manager, deliverables) has(project-manager, clear(objective)) }

Evaluation	Comments
4	Selection: A Go player may sacrifice some stones if there is a move elsewhere that is bigger in terms of achieving the goal. Mapping: Structure is 1:1; Similarity – In Go, a player may sacrifice a group of stones to obtain something of equal or more value in terms of achieving the goal. Similarly, a project manager should be willing to sacrifice deliverables (whether completed, planned or in-progress) to take advantage of a better opportunity for achieving the project goal; Purpose of the principle is the same in both Go and PM. Inferences: A project manager should be willing to sacrifice some work (whether completed, planned or in-progress) to take advantage of a better opportunity for achieving the project goal. Evaluation: This principle is not easy to do in Traditional PM – it would require a change request and strong negotiations; but it is championed in Agile, e.g. Highsmith (2004, p. 11). Closely related to G60. Learning: Continually re-evaluate the work already done and yet to do as you look for the best way to achieve the goal.
4	Selection: It is one thing to be willing to sacrifice something, but knowing if, what and when requires a clear understanding of the objective and its relation to the goal. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager may sacrifice some work, but knowing if, what and when requires a clear understanding of the objective and its relation to the goal. Evaluation: This is part of the Agile method of reprioritizing the Scope Bank after each cycle (Schwaber, 2004; Wysocki, 2009) Differences (unmapped): This is closely related to G59, plus Always know the goal (G83) and Commit to the objective (G75) Learning: Be willing to sacrifice something for something else that more clearly helps achieve the goal.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G61	Don't follow your opponent; Make your opponent follow you; sente; tenuki [Take the initiative]	Take(player, initiative)	Takes ↔ Takes player ↔ project-manager initiative ↔ initiative	Take(project-manager, initiative)
G62	Let the opponent drive you to victory; Lead, even when you follow; Let the opponent take the smaller territory [Follow when the opponent is going your way]	When{ follow(player, opponent), helping(opponent, player) }	Follow ↔ Follow player ↔ project-manager opponent ↔ opposition helping ↔ helping player ↔ project	When{ follow(project-manager, opposition), helping(opposition, project) }

Evaluation	Comments
5	Selection: As much as possible, a Go player tries to take and keep the initiative. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager needs to take and keep the initiative. Evaluation: There is alignment between this Go principle and PM, e.g. (Cleland & Ireland, 2007, pp. 390-398). The ICB includes this principle under Leadership (e.g. having a vision and bringing it to life) and Assertiveness (e.g. avoids being led or manipulated by others) (Caupin et al., 2006). Learning: A project manager needs to take and keep the initiative to achieve the goal.
3	Selection: Follow the opponent when it helps the player achieve the player's goal. E.g. If the opposition is weak or illogical, and their demands help achieve the project goal, then do as they ask! Mapping: Structure is 1:1; Similarity – Player is mapped to both project manager and project in this principle. Both the player and the project manager should consider following the opposition when the opposition is helping the player / project to achieve the goal; Purpose of the principle is the same in both Go and PM. Inferences: Follow the opposition when it helps the project achieve the goal. Evaluation: I'm not sure this is included in any project management literature, but it is part of negotiation tactics (e.g. Fisher, et al. (1991)) Learning: Allow the opposition to help achieve the project goal.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G63	Komi [A player has a 50% chance of winning]	Cause[Give(player, points, opponent) : OR(komi, handicap), Equal-opportunity(player, opponent)]	Give ↔ Give player ↔ project-manager points ↔ value opponent ↔ opposition Equal-opportunity ↔ Equal-opportunity player ↔ project	Cause[Give(project-manager, value, opposition) : OR(komi, handicap), Equal-opportunity(project, opposition)]

Evaluation	Comments
1	Selection: One player gives the other points or handicap to ensure a 50:50 chance of winning. The game of Go is intended to be a fair contest between players. The first move is so advantageous that the player playing Black (the player who moves first) gives points to the White player in order to even the odds (Richard Bozulich, 2001, p. 350). Mapping: Structure is 1:1 but not isomorphic; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager gives tips to the opposition tips to ensure a 50:50 chance of achieving the goal. Evaluation: Not intentionally! Organizations usually want a high probability of achieving the goal (Crawford et al., 2002). These are usually the ones most likely to get approved (Levine, 2005, pp. 35-37). But, assigning an inappropriate project manager to a project is like giving some points to the opposition; i.e. it reduces the odds of achieving the project goal , e.g. Worsley and Docker (2000), Kerzner (2009b). Similarly for providing insufficient time or resources (Project Management Institute, 2008a) or management attention (Laufer, 2009). Differences (unmapped): To maximize the chances of success, the project should be given everything needed. However, resource limitations come into play, so the role of portfolio management is exposed here, e.g. Maximizing value to organization (not just one project) via distribution of resources E.g. Kendall and Rollins (2003). Learning: Give a project the resources it needs to be successful.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G64	Play to the board, forget the opponent; The board tells no lies; When you're ahead don't be happy, when you're behind don't be distraught [Be objective]	Be-Objective(player)	Be-objective ↔ Be-objective player ↔ project-manager	Be-Objective(project-manager)

Evaluation	Comments
5	Selection: A Go player needs to be objective when analyzing the situation (G3) and the trajectory (G65), and when making decisions. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager needs to be objective when analyzing the situation and the trajectory, and when making decisions. Evaluation: Project management literature agrees with this principle (e.g. rational decision making e.g. Cleland and Ireland (2010) or value-oriented decision-making, e.g. Hammond et al. (1999), but a person needs to be emotionally engaged with the activity to increase competence (S. Dreyfus, 2004). Differences (unmapped): Closely related to G70, and also G03 and G65). Learning: Be objective when analyzing and making decisions.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G65	Your own plans are hard to see, the opponent's even harder [Analyze the situation and the trajectory]	Analyze(player, AND(situation, trajectory))	player ↔ project-manager situation ↔ situation trajectory ↔ trajectory	Analyze(project-manager, AND(situation, trajectory))
G66	Have a good next move [A good move has a good follow-up]	Find(player, move, good-follow-up(move)): good(move)	player ↔ project-manager move ↔ activities good-follow-up ↔ good-follow-up good(move ↔ good(planning)	Find(project-manager, activity, good-follow-up(activity)): good(planning)

Evaluation	Comments
4	Selection: Analyze the situation at the moment, and the trajectory of play. A player cannot know the depth of plans of the opponent just by looking at the board. A player needs not only a point-in-time analysis, but also an understanding of the trajectory of each player. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Analyze the situation at the moment, and the trajectory of the context. Evaluation: There is inherent uncertainty in projects (Caupin et al., 2006; Project Management Institute, 2008a). Earned Value analysis is one of the project management techniques for analyzing the situation and trajectory of a project, and is recommended by the likes of Project Management Institute (2008a), Meredith and Mantel (2009), Kerzner (2009b), and Wysocki (2009). But it forecasts the future based exclusively on past performance from a deterministic perspective. Analyzing the trajectory requires understanding the "direction of play" (Kajiware, 1979) and anticipating what the future might look like, in order to attempt to influence that future. This requires a completely different way of thinking (Saynisch, 2010b). Learning: Recognize the inherent uncertainty in a situation, and then analyze it as much as possible. See also G03, G10, G19, G20, G49, G51, G67, G76, G80.
4	Selection: A Go player makes sure that a move has a good follow-up move after it; otherwise it is probably not a good move. This follows from G10, G14, G28, G35, G41, and G73. The follow-up need not be in the same local area, though. Mapping: Structure is 1:1; Similarity – A potential move in Go is like a planned activity in project management (See comments to G01). In Go, we refer to a good move (which includes planning behind it), but in PM we refer to good planning rather than a good activity; Purpose of the principle is the same in both Go and PM. Inferences: A project manager should ensure that each activity has a good follow-up after it. Evaluation: This principle applies more to projects in dynamic contexts. In Agile methods, this principle is followed when planning each cycle (Highsmith, 2004; Schwaber & Beedle, 2002; Wysocki, 2009) Learning: In dynamic projects, activities should be planned to be flexible so they can be used if any of a number of foreseeable situations materialize, with appropriate follow-on activities.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G67	Use probes ; Don't take the bait [Use a probe to gather information to clarify a situation]	When{ Cause[make(player, probe) , make(opponent, move) : opponent-decision], NOT-understand(player ,opponent(intentions))}	Make ↔ Make player ↔ project-manager probe ↔ probe move ↔ act opponent ↔ opposition NOT-understand ↔ NOT-understand intentions ↔ intentions	When{ Cause[make(project-manager, probe) , make(opposition, act) : opposition-decision], NOT-understand(project-manager,opposition(intentions))}

Evaluation	Comments
4	Selection: In the game of Go, when a player does not understand the opponent's intentions in an area, the player plays a probe – a move that allows the opponent to respond in one of several ways, each of which is a commitment to a particular direction of play. Responding to a probe takes away some of the opponent's flexibility and weakness, but reveals the opponent's intentions. This small investment is used to gather information, especially when invading deeply into opponent territory. Then the player performs an analysis (e.g. G03, G65) to determine how to proceed. Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: When a project manager does not understand the opposition's intentions, use a probe to force the opposition make a decision. Evaluation: In project management, when the requirements are unclear there are several way to clarify the situation: one is to set up a preliminary project to gather the information; another is to use the first phase of the project to gather more information. Methods such as Agile and Last Planner allow some requirements to remain unclear until later in the project. In decision-making, one of the first steps in an unclear situation is to gather information (Cleland & Ireland, 2007). A probe is an information-gathering tool – just one that is not often mentioned in project management. A probe could also fit within the learning-and-fast-response approach of Loch et al. (2006). Consequences: A probe helps solidify the opposition's position - making it more difficult for the project manager to take advantage of any weaknesses there. Learning: Use a probe to gather information to clarify a situation. Often it forces the opposition to commit to a plan of action – before the opposition is ready to make that commitment.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G68	If you lead be careful, if you follow be careful	Take(player, initiative): risky NOT-Take(player, initiative: more-risky	Takes ↔ Takes player ↔ project-manager initiative ↔ initiative	Take(project-manager, initiative): risky NOT-Take(project-manager, initiative: more-risky
G69	Balance leading and following	keep-balance-between(leading, following)	Keeps-balance-between ↔ Keeps-balance-between leading ↔ leading following ↔ following	keep-balance-between(leading, following)

Evaluation	Comments
4	Selection: Pushing hard to reach a goal involves a threat of failure, but not pushing almost guarantees failure to reach the goal. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Taking the initiative is risky for a project manager, but not taking the initiative is even more risky. This principle uses the term "risk" in the negative – i.e. a project manager not taking the initiative has a higher risk of negative consequences to the project than if the project manager does take the initiative. Evaluation: In PM, taking the initiative includes all of the PM tasks, e.g. planning, risk management, scope management, etc. In other words, project management is risk management (Hillson, 2009) Closely related to G61. Learning: Risk is inherent whenever there is an objective to be reached.
4	Selection: In the game of Go, it is not possible to always lead – that leads to over-reaching and strong counterattacks by the opponent. A player has to give up the lead sometimes to fix weaknesses. There is an ebb-and-flow, a give-and-take, a balance of lead-and-follow. Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Keep balance between leading and following. Evaluation: Some writers point out that leaders both lead and follow (Cleland & Ireland, 2007), while others expect project managers to be assertive directors for the entire project (e.g. Caupin et al. (2006, pp. 86, 94). Inferences: A project manager needs patience (G70) and a long view.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G70	Self-control [Control your emotions]	Control(player, AND(thinking, emotions))	Control ↔ Control player ↔ project-manager thinking ↔ thinking emotions ↔ emotions	Control(project-manager, AND(thinking, emotions))
G71	Focus; Narrow; Hone in [Focus on a single objective when the situation is clear]	When[focus-on(player, single(objective)), clear(situation)]	Focus-on ↔ Focus-on player ↔ project-manager single ↔ single objective ↔ objective clear ↔ clear situation ↔ situation	When[focus-on(project-manager, single(objective)), clear(situation)]

Evaluation	Comments
5	Selection: Go players control their emotions: during a game they will feel elated and threatened, frustrated and despondent, among many other feelings. But they must not allow those feelings to control their thinking and actions. Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Project managers control their thinking and emotions. Evaluation: Project managers are expected to control their emotions, e.g. Self-control is one of the behavioural competences in the ICB, i.e. Caupin et al. (2006). See also (G64). Learning: Control your emotions.
5	Selection: When the situation is clear, Go players can focus all their energy on a single objective. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Focus on a single objective when the situation is clear. Evaluation: In project management, in conditions of low uncertainty, it is efficient to create a detailed plan and to follow the plan, allowing some contingency for minor variability (Loch et al., 2006). This is the assumed situation underlying TPM, and incorporated into Project Management Institute (Project Management Institute, 2008a), e.g. the Planning process group. This principle is closely related to G41 (deep planning), Learning: Focus on a single objective when the situation is clear.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G72	Take the other miai [Take the other equal opportunity]	EQUAL(#1(opportunity), #2(opportunity) : miai When { Take(player, #2(opportunity)), Take(opponent, #1 (opportunity)) }	Equal ↔ Equal Opportunity ↔ opportunity Take ↔ Take player ↔ project-manager opponent ↔ opposition	EQUAL(#1(opportunity), #2(opportunity) : miai When { Take(project-manager, #2(opportunity)), Take(opposition, #1 (opportunity)) }
G73	Play moves with multiple meanings; The more meanings the better; Do more than one thing at once	Choose[player, move, AND(multiple(purposes), best(move,each(pu rpose)))]	player ↔ project-manager move ↔ activities multiple ↔ multiple purposes ↔ purposes best ↔ best each ↔ each	Choose[project-manager, activity, AND(multiple(purposes), best(activity,each(purpose)))]

Evaluation	Comments
3	Selection: When there are two or more equal opportunities, and the opponent takes one – the player should take the other. By implication, taking this action is not urgent until the opponent takes the one action. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: When there are two or more equal opportunities, and the opposition takes one – the project manager should take the other. By implication, taking this action is not urgent until the opposition takes the one action. Evaluation: I have not been able to find this concept discussed in the project management literature. Learning: When prioritizing activities in a dynamic environment with strong opposition, estimate each activity's value to the project and pursue the one with the highest value (G28). If there is a tie between two, do neither.
4	Selection: Go moves should have more than one purpose, thus they are flexible and can be followed-up in more than one way – depending on what the opponent does. The most famous such move is the "ear-reddening move" played by Shusaku against Gennan Inseki in July 1846, in which move 127 does four different things well, and gets the young Shusaku out of trouble. See (Power, 1982, pp. 99-110) for a commentary on the game, and p.106 for the move itself. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager should look for activities that have multiple purposes, and preferably the best activities for each purpose. Evaluation: One way to handle uncertainty using this principle is to use a process-oriented project life cycle, e.g. concept, feasibility, design, build, test, implement, operate – each phase reducing uncertainty (and options) before going to the next (Morris, 2002). Agile methods acknowledge uncertainty and recommend doing actions early that will reduce risk and uncertainty and also provide value early, as well as prepare for later, whichever future path is taken, e.g. Laufer (2009), Wysocki (2009). Learning: Flexible actions (with multiple meanings) better prepare a project manager for whatever the future brings. But each meaning should be full, not lukewarm (G09). In general, the more of GO'S RULES that are correctly addressed with each activity, the better.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G74	Build thickness [Use influence to help create value in the future]	EQUAL[potential(points) : influence, now(points) : territory] Cause{ Create(player, influence), Take-later(player, territory) }	Equal ↔ Equal potential ↔ potential points ↔ value now ↔ now influence ↔ influence territory ↔ immediate-value Create ↔ Create Take-later ↔ Take-later player ↔ project-manager	EQUAL[potential(value) : influence, now(value) : immediate-value] Cause{ Create(project-manager, influence), Take-later(project-manager, immediate-value) }

Evaluation	Comments
5	Selection: In the game of Go, a player creates thickness to influence play over the whole rest of the board. It does not directly create territory (i.e. it does not directly help achieve the goal), but it indirectly allows the player to create territory elsewhere by providing support during, and even preventing, future fights. Some players take this to the extreme, playing an influence-oriented game (e.g. Takemiya (Zhou, 2008b)), which is a high-risk / high-return strategy. Neither can be used exclusively. Mapping: Structure is 1:1; Similarity – Surrounding territory in a game of Go is like producing 'interim' deliverables in a project - they create immediate value for the client. In the game of Go, value is defined primarily in terms of points of territory.; Purpose of the principle is the same in both Go and PM. Inferences: A project manager can use influence to develop the potential for creating value in the future, or can create value immediately. The choice is a matter of style. Evaluation: Creating influence in projects usually means having influence with (human) project stakeholders. It is a way to manoeuvre actions and opinions in a favourable direction. See Pinto (1996, pp. 145-152, and especially pp148-150), and Dinsmore and Cooke-Davies (2006) Also see ICB behavioural competencies, e.g. assertiveness and negotiation in Caupin et al. (2006). Project Management Institute (2008a) briefly described some interpersonal skills for project managers, including influencing, in an appendix new to this edition. More explicit information and methods are available in, for example, Daniel (2007) and Hiatt (2006). Learning: Influence is needed to create value in the longer-term.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G75	Complete the pattern [Commit to completing each objective]	Commit(player, objective))	Commit ↔ Commit player ↔ project-manager objective ↔ objective	Commit(project-manager, objective))

Evaluation	Comments
5	Selection: In the game of Go, once a player has decided on a short-term objective (e.g. a joseki or tesuji), it is usually (but not always), better to complete the plan before changing to a different objective because changing creates an opportunity for the opponent to exploit. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Commit to completing each started objective. This implies not starting objectives without being positive of being able to complete them. Evaluation: Dvir and Lechler (2004) find that goal and plan changes are devastating for project success. "Of all the characteristics desirable in a PM, this *drive to complete the task* is the most important." (Meredith & Mantel, 2009, p. 127). This is recognized in Agile methods – which allow no changes during a sprint, see Schwaber (2004) Learning: Finish what you start.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G76	Don't resolve uncertainty before its time [Maintain uncertainty as long as possible]	When{ Cause[Make(player, move), understand (player, opponent(intentions))], More-important-than(clarity, uncertainty) : Good Timing }	Make ↔ Perform player ↔ project-manager move ↔ activity opponent ↔ opposition understand ↔ understand intentions ↔ intentions More-important-than ↔ More-important-than clarity ↔ clarity uncertainty ↔ uncertainty Good-Timing ↔ Good-management	When{ Cause[Perform(project-manager, activity), understand (project-manager, opposition(intentions))], More-important-than(clarity, uncertainty)) : Good Timing }

Evaluation	Comments
4	Selection: In the game of Go, uncertainty has value and affects both players. A player leaves options open to take advantage of later, or for the opponent to make mistakes. Go players resolve the uncertainty as late as possible. Mapping: Structure is 1:1; Similarity – A Go player makes a move, a project manager performs an activity. Good timing for a Go player implies making a move as late as possible yet achieving its full benefit; Purpose of the principle is the same in both Go and PM. Inferences: When clarity if more important than uncertainty, a project manager should perform an activity that will reveal the opposition's intentions Evaluation: Projects in dynamic environments need to accept uncertainty and commit to a decision as late as possible to allow time for information gathering and understanding of the situation and trajectory. E.g. Sobek, Ward, and Liker (1999). Even construction projects do not resolve uncertainty until after construction has started (Laufer, 2009, pp. 23-25). Learning: Project managers in dynamic environments need to accept uncertainty and commit to a decision as late as possible to allow time for information gathering and understanding of the situation and trajectory

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G77	The key to planning is the planning, not the plan [Planning is more important than the plan]	More-important-than(planning, plans)	More-important-than ↔ More-important-than planning ↔ planning plans ↔ plans	More-important-than(planning, plans)

Evaluation	Comments
5	Selection: In the game of Go, an effective analysis of the board (G03 and G65) to find likely good places to play, combined with deep reading (G41), provide most of the information required to decide where to play next. Some of the other factors are: the score (G49), the riskiness of the alternative (G22), the likely future moves of the opponent (G20, G51), and how well each alternative support achieving the goal (G01, G73, G83). All of this thinking/ planning prepares the Go player to be flexible and adaptable in light of the uncertainty of how the opponent will play. Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Planning is more important than the plan. Evaluation: One of the principles of TPM is "Plan the project work, and adhere to the plan." (Cleland & Ireland, 2010, p. 207), yet the same authors also say "No plan is perfect to carry one through an entire project, but a good plan does provide a path from which on can adjust to meet the changes." (Cleland & Ireland, 2007, p. 284), recognizing that even the best plans have to change to some extent. Agile methods recognize and accept that change happens, and that using an iterative process "takes into account the reality that we almost never get anything completely right the first time." (Van Cauwenberghe, 2004, p. 80). Especially with new product development, the product or market can change from the time the project is launched until the product is on the market. The PM process needs to adapt to that environment. (Highsmith, 2004, pp. 4-5). Winter and Szczepanek (2009) suggest that an insufficient understanding of the problem (e.g. not viewed from enough perspectives) often leads to solving the wrong problem, and the need to replan. Learning: Planning is more important than the plan. The process of planning is important by preparing the project team to meet likely eventualities, but a specific plan is only that – an estimate or guess regarding the future.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G78	Balance expansion and focus	Keep-balance-between(expansion, focus)	Keeps-balance-between ↔ Keeps-balance-between expansion ↔ expansion focus ↔ focus	Keep-balance-between(expansion, focus)

Evaluation	Comments
4	Selection: In the game of Go, the early part of the game is primarily about expansion, decreasing non-linearly until the last part of the game, which is primarily about focus. Because of the nature of the uncertainty (i.e. unknown impacts of actions, frequent change, strong opposition), the definition of the goal for a particular game is not fixed until very late in the game, so Go players remain flexible in their deployment of resources – expanding perspective to take advantage of opportunities when presented, and fiercely focussing on achieving each interim objective. Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Keep balance between expansion and focus. Evaluation: In project management, uncertainty decreases through the life of a project (Project Management Institute, 2008a, p. 17). In TPM uncertainty is reduced as the final deliverable is more clearly defined. Agile methods allow the definition of the goal to change as the team and client converge on their understanding of what provides value, the capabilities of the available team and resources, and the constraints of time and money (Highsmith, 2004; Schwaber, 2004; Wysocki, 2009). Learning: Keep balance between expansion and focus.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G79	Plan your exit/ sacrifice strategy [Plan how to exit a situation before entering]	Choose(player,move, how-to-exit(situation))	player ↔ project-manager move ↔ activities how-to-exit ↔ how-to-exit situation ↔ situation	Choose(project-manager, plan, how-to-exit(situation))

Evaluation	Comments
5	Selection: Before entering into a new situation, a Go player plans an escape route / has a backup plan. This principle relates to both resigning a game and to leaving a particular situation in a game. Resigning is an art – there is no formula for when to do it, but "the older generation of players, who received their training in the early part of this century, take particular care over the timing of their resignations." From the essay "The Art of Resigning" in (Nakayama, 1984), quote from p.46. Leaving a particular situation during a game is done for a variety of reasons, e.g. deception (G31), to make a bigger move elsewhere (G28), to create complications (G22), (G80). Mapping: Structure is 1:1; Similarity – Same; Purpose of the principle is the same in both Go and PM. Inferences: Before entering into a new situation, a Go project manager plans how to exit the situation. Evaluation: It is not the project manager's or the project team's decision regarding whether to terminate a project or not – it is up to the project sponsor / governors. However, this principle suggests considering some criteria for deciding when to terminate projects. If portfolio management is in place this principle should be incorporated into those processes, e.g., Project Management Institute (2008b), Caupin et al. (2006), and Wysocki (2009). This principle also suggests that it is sometimes appropriate to stop some activities on a project and switch to doing something else – and that there should be some criteria for doing so. Risk management planning encourages this type of thinking, e.g. fallback plans and contingency plans, identifying residual risks and secondary risks, etc. (Project Management Institute, 2008a, p. 306). Learning: Projects and portfolios should have not only processes for, but also criteria for, terminating projects and for changing activities during a project.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G80	Leave aji before leaving; Don't kill aji [Create uncertainty for the opponent]	Choose{ player, move, Cause[move, opponent(unclear(situation))] }	player ↔ project-manager move ↔ activity opponent ↔ opposition unclear ↔ unclear situation ↔ situation	Choose{ project-manager, activity, Cause[activity, opposition(unclear (situation))] }

Evaluation	Comments
4	Selection: In the game of Go, this principle is used frequently throughout a game. Creating uncertainty in the opponent's territory weakens it, and allows the player the potential for future opportunities. When there are several areas of uncertainty at the same time (as is typical in the midgame of a game of Go), the situation becomes complex (in the complexity science sense). Even top Go professionals feel powerless when faced with this degree of complexity. For example, Sakata, the top player in the world at the time, stated that he was hopeless at go (Nakayama, 1984, p. 79). Ancient Chinese military strategy is one source of ideas (Ma, 2000). Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager should plan activities that create uncertainty for the opposition. Evaluation: This principle assumes an active, strongly negative opposition. Pinto (1996, pp. 84-85) mentions deception and divide-and-conquer as a couple of political tools. This is a significant item in negotiation literature, e.g., Guidice, Alder, and Phelan (2009), Lewicki & Hiam (2006). Differences (unmapped): Related to G31, G32, G38. Learning: When there is strong opposition, create uncertainty for it. Some tactics used in the game of Go are "divide and conquer" (G38), deception (G33), distraction (G31, G32), sacrificing something (G59), and ignoring them (G61).

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G81	There are no rules; Don't rely on simple proverbs [The player is responsible for all decisions]	Cause[go's-rules, choose(player, move, good(move))] NOT-Cause [go's-rules, choose(player, move, guaranteed(success))]	go's-rules ↔ go's-rules player ↔ project-manager move ↔ activity good ↔ good move ↔ plan guaranteed(success) ↔ guaranteed(success)	Cause[go's-rules, choose(project-manager, activity, good(plan))] NOT-Cause [go's-rules, choose(project-manager, activity, guaranteed(success))]

Evaluation	Comments
5	Selection: Finding the right balance of all Go's rules will allow a Go player to consistently play good moves, and to become a good player, but they will not always lead to the best move, or make a person a great player. To do that, a player must go beyond the rules. The player must take responsibility for finding the best move every move to achieve the goal. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: Following GO'S RULES helps a project manager choose activities that make a good plan, but they do not guarantee success. The project manager has that responsibility. Evaluation: The project manager is responsible for achieving the project goal. (Project Management Institute, 2008a). Following these principles (or any standard or methodology) will allow a project manager to find a good way to move forward, but perhaps not the best way for the circumstances, and certainly does not guarantee success. PM writers also identify the need for balance, e.g. Laufer (2009) identified five project management principles, stating that they must be in balance Learning: Learning and following GO'S RULES helps a project manager do well, but to excel requires going beyond them.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G82	Strive for perfection [Always do your best]	Cause[Has(player, right(spirit)), Find(player, every(move), best(move))]	player ↔ project-manager right(spirit) ↔ right(spirit) move ↔ activity every ↔ every best ↔ best	Cause[Has(project-manager, right(spirit)), Find(project-manager, every(activity), best(activity))]

Evaluation	Comments
5	Selection: This principle extends from the last one (G81). A Go player needs the right spirit to look for the best move every move. It took the great Sakata 10 years to learn the lesson of tenacity that would propel him from second-best to best player in Japan (Terry, 1987). Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: A project manager needs the right spirit to find the best activity for every activity in a project. Evaluation: A common pitfall of decision-making is choosing the first solution. Hammond et al. (1999) recommended looking beyond the first choice to find a better solution (similar to (G10)). Winter and Szczepanek (2009) recommend viewing a project from several perspectives to better understand the problem before trying to solve it. Turner (2006b), developing his theory of project management, recognized the need for good attitudes, although he does not specify what those are. Cleland and Ireland (2007, pp. 394-395) identified eight characteristics of the successful project manager, almost all aligning with Go principles: capability to conceptualize the likely deliverables of the project (G83); have an optimistic attitude (G52); have a tough skin (G07, G08); empower project team members; ability to assume risk (G17, G22, G23, G26, G68); ability and courage to make decisions (G19, G28, G61); tenacity (G31, G32, G75, G82); and ability to mentor (inverse of G58). Learning: Do your best at all times.

GoID	Proverb	Go Predicates	Mapping	Inferred PM Predicates
G83	Know your goal	Know(player, goal)	Know ↔ Know player ↔ project-manager goal ↔ goal	Know(project-manager, goal)

Evaluation	Comments
5	Selection: In the game of Go, the goal is the point of the game – to win, and that is done by having more points than the opponent. It is surprising how frequently players forget this in the heat of play. Mapping: Structure is 1:1; Similarity – See previous comments; Purpose of the principle is the same in both Go and PM. Inferences: The project manager must know the goal of the project. Evaluation: A project has a goal or objective of some kind, which the project manager is assigned to achieve (Project Management Institute, 2008a). The degree of clarity of the goal can determine the way that a project is managed , e.g. Turner and Cochrane (1993). Project managers are susceptible to many psychological traps when making decisions, e.g. Hammond et al. (1999, pp. 185-213), B. Richardson (2009, pp. 43-58). Learning: Knowing the goal (and applying Go's rules in general) helps prevent project managers from falling into psychological traps.

5 Applying Go Principles to Project Management

Previous chapters have developed many strands of thought – this chapter brings them together. Chapters 1 and 2 looked at the concepts of project, project management and the project manager from the perspectives of the game of Go and of project management. This chapter continues that analytical structure.

Chapter 4 referred to groupings of principles in this chapter. A few will be looked at: principles for dealing with changes, uncertainty, weaknesses, conflict, decision-making and with the use of influence, plus the concept of project and some characteristics of project managers. This variety of ways of looking at Go principles and at project management provide one more illustration that there is more than one way to play Go or to lead projects.

5.1 Understanding Complex Problem Projects

The previous chapter demonstrated that the game of Go and project management have similar underlying structures: they have a purpose, are unique, exist within a larger context, deal with frequent change, complexity, complication, conflict, and uncertainty of various types, including unclear definition of the goal and insufficient or unreliable information needed to make decisions.

Section 4.4 described the target type of project, but I want to emphasize a point here: projects deal with making decisions under uncertainty (consisting of at least complexity and frequent change) and enduring conflict, in addition to the "simpler" conditions of risk and certainty. Mayer (2009, p. 24) described enduring conflict very well:

> Enduring conflict is that aspect of a dispute that is embedded in structures, systems, values, or identity and will therefore not be resolved through short-term, resolution-oriented conflict interventions. Enduring conflict is long lasting because of its nature, not because of ineffective or inappropriate efforts to resolve it. Until the roots of the conflict change, the system evolves, or the identity- or value-based elements are profoundly transformed, the conflict will remain, although how it is manifested may vary over time.

Mayer (2009, pp. 32-34) later identified some of the problems people have when dealing with enduring conflict:

> Even when we are faced with the most intractable and intense conflicts it is important that we understand there are alternatives to either immediate resolution or despair, to victory or defeat, or to dominance or submission. ... we need to accept, even embrace, certain paradoxes that are almost always present in enduring conflict, and we all need to be able to live with uncertainty…. [There are] three paradoxes:
>
> - There is no comprehensive solution that will fix this problem, but taking action directed to the comprehensive nature of the problem is critical.
> - Many different players with profoundly different viewpoints will have to engage in a long-term struggle about what to do to deal with the problem, but cooperation is essential.

- We have to act decisively and with conviction, but we must do so before we are completely certain of the ramifications of our actions.

The other point I want to emphasize is that of relationships. Positions are defined by relationships between a Go player's stones and groups of stones, and those of the opponent. From a project management perspective, the project organization and each of the stakeholder organizations are defined by the relationships between them. Here, too, the relations are dynamic, changing continuously. Relationships (in Go and in projects) can be strengthened or weakened, broken or restored; but they cannot be made permanent (Hernes & Bakken, 2003).

These points point to the basic differences from traditional project management: TPM assumes change is infrequent vs. Go's frequent change, TPM sees complication and Go adds complexity, TPM deals with conflicting priorities and Go also deals with active opposition, TPM views uncertainty to be mostly deterministic, Go adds indeterminacy.

5.1.1 Complex Problem Solving

Having discovered that the game of Go and project management share the characteristics of complex problem solving (CPS), how do the strategies for solving complex problems compare to those for playing Go or managing projects?

They are very similar, but unfortunately that is not very helpful, yet. The CPS tasks have not been put together into a theoretical framework. However, this is a list of the criteria that have been commonly used (Quesada et al., 2005):

- Planning-based vs. skill-based. This dimension could also be called predictive vs. reactive. "non-reactive tasks tend to be more complex and perceived as more difficult" (p.23).
- Knowledge-intensive vs. knowledge-lean. "people tend to learn a lot of new knowledge during long periods of controlling the system" (p.24).
- Search-based vs. understanding-based. "(VanLehn, 1991) argues that understanding does not run to completion before search begins, but the two processes alternate and even blend together." (p.25) [This is very similar to Laufer's discovery as recalled in Laufer (2009, p. 24)].
- Decomposability under human constraints without information loss. Most tasks are decomposable into smaller sub-problems, but some require processing in parallel. "anything above quaternary relations are supposed to be out of the conventional limits of working memory", i.e. they cannot be broken down, nor can they be processed as a unit, making the system is too complex for humans to understand completely.
- Ill-defined vs. well-defined. This is related to the understanding-based criteria: well-defined problems can be handled by the general problem solver.

"It is thought that *holistic*" approaches to complexity have a better chance of success, in that they do not need to decompose tasks into sub-components." (Quesada et al., 2005, p. 28).

Based on the above, project managers and teams are required to plan their activities, to learn while doing, to use purposeful trial-and-error for both defining the goal and at the same time finding its solution, and to recognize the relational complexity of situations, using reductionism where possible, and otherwise accepting that there will be a loss of information when thinking about the problem (i.e. when the number of unique entities that one must process in parallel to arrive at a solution is greater than four (Halford, Wilson, & Phillips, 1998)). Since GO'S RULES tries to balance seven highly interconnected dimensions at once, the game of Go, and by inference projects, cannot be managed with complete information.

5.2 Ways of Managing Projects

Managing this type of project is different from managing projects in the traditional way.

Chapter 1 argued that traditional Project Management does not very well deal with conditions of uncertainty, change, conflict, multiple goals, and complexity, but that players of the game of Go had developed some heuristics for these types of problems. The next sections describe these heuristics as they might be used for managing projects.

Some Go principles only apply to one of the characteristics identified in section 4.4, but most are not specific – they are part of a mesh of principles that together address the complexity of actual play and actual projects, in other words: complex problems. As project management principles must be applied as part of an integrated set in order to successfully deliver a project. The principles that address specific situations are discussed next, followed by integrated views.

So, how can the game of Go help project managers deal with conflicting priorities, frequent change, uncertainty, evolutionary development, and complexity?

5.2.1 Decision-Making

Managing uncertainty is project management, and making decisions under uncertainty is one of the primary roles of a project manager (Winch, 2004). Section 2.1.7 used the Hammond et al. (1999) decision-making approach for the game of Go. Here the same approach is used for project management. Figure 7 is a reminder of the flow of the process. The following sections will describe a way to deal with various characteristics of complex problem projects using this decision-making approach. The flow is described in the next section. Then in following sections only aspects of the process that apply to that section will be described.

It is easy to fall into psychological traps such as wishful thinking or following the opponent (see Hammond et al. (1999) and B. Richardson (2009) for more on this topic). Many of the Go principles are intended to combat these traps.

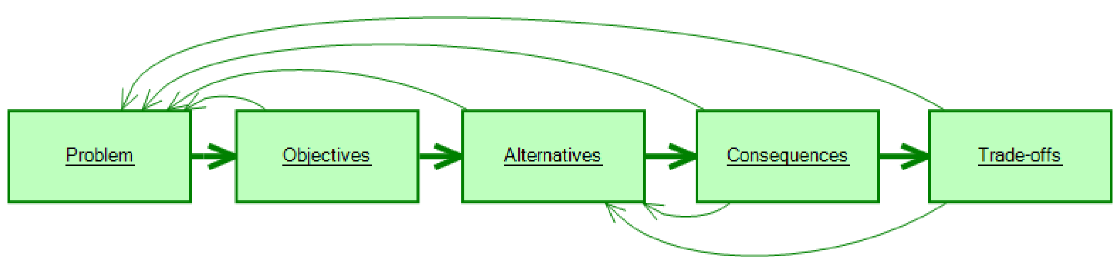

Figure 7. Decision-making process based on Hammond et al. (1999)

5.2.2 Dealing with Frequent Change

Recognizing the need for a decision requires first recognizing that something in the environment has changed or is changing such that the project team is in danger of not achieving the project goal. Change is always occurring, so the project team needs to determine the scale of change related to achieving the project goal. In other words, the project team has an ongoing mandate to continually evaluate changes in the entire project context. See Figure 8 for an illustration of Go principles used for dealing with frequent change.

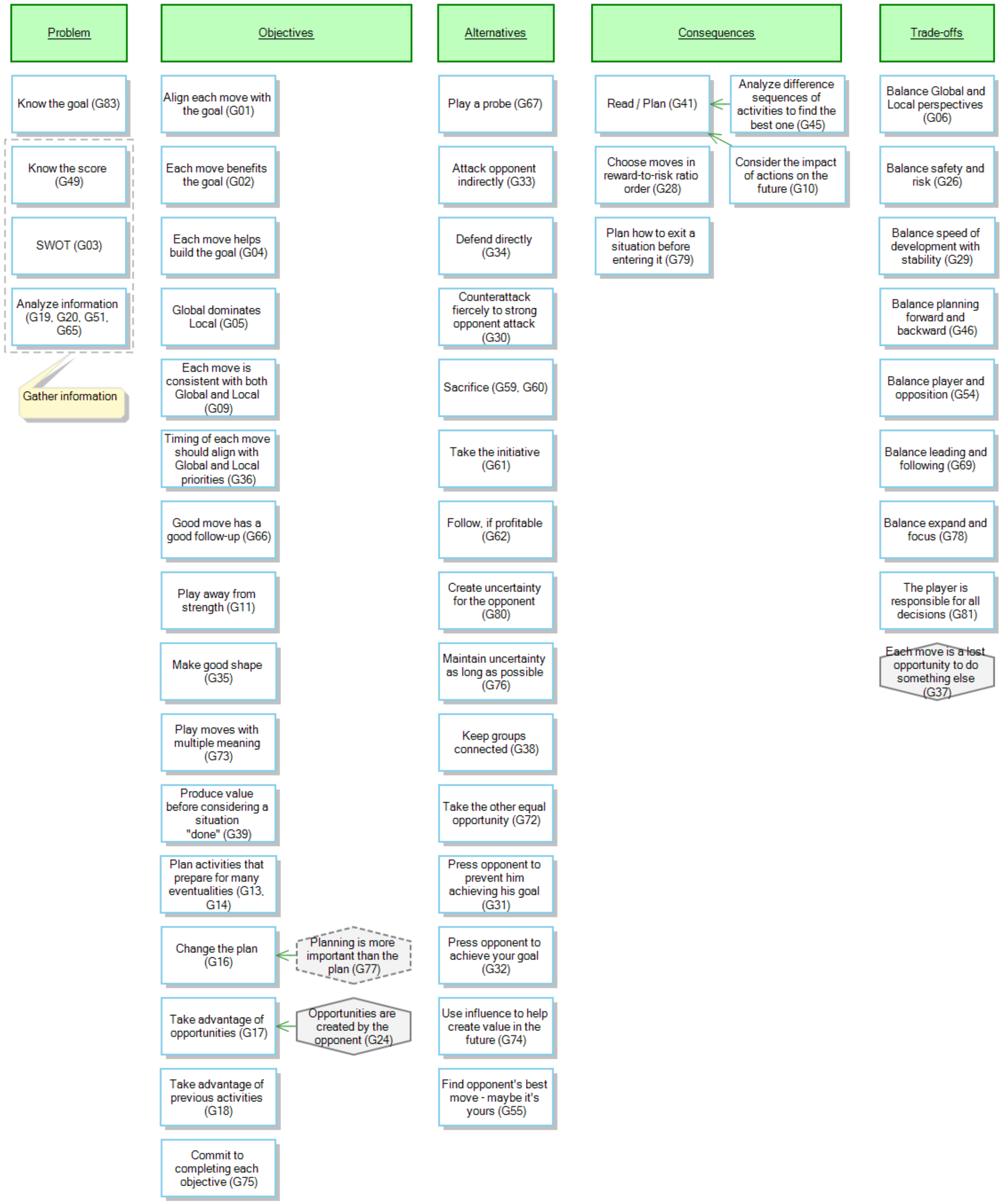

Figure 8. Dealing with change

5.2.2.1 Problem

Define the current problem (because most problems in a project or the game of Go are linked), i.e. there is more than one problem, ensuring it is the right problem for the moment. The definition of the problem may change – not only throughout the project, but throughout the analysis and learning that occurs every step along the way. The main activity in this step in the decision-making process is to gather relevant information to provide insight into the forces and factors that suggest the need for a decision. It is necessary to understand the goal of the project to provide context for any decision. It is also necessary to know the status of the project regarding attaining the goal. Without a clear understanding of the goal and of the project status, decisions will be sub-optimal. To obtain a clear understanding of the status, the project team needs to analyze the static situation at a point in time, and also to analyze the trajectory of the project and of changes in the project context over time. For example, what are the motivations of opposition to the project or project goal? A SWOT analysis is a good way to start the analysis, that is, what are the strengths of the project / project team, what are its weaknesses, what opportunities exist that the project team might be able to take advantage of, and what threats could be made against the project? (G83, G49, G65, G20, G19, G03)

Integrating and analyzing the results of these investigations will indicate whether a decision is required regarding changing the current plan. The following questions will help determine whether the decision needs to be made right away.

1. Is the change too big to be ignored? i.e. Will the combination of current and anticipated changes destroy more value than will be added by following the current plan? Do the changes seriously threaten achieving a deliverable?
2. Is there a significant opportunity that should be seized immediately? i.e. Can more value be added by seizing the opportunity than by following the current plan?

If the answer is yes to either of these two questions, the project team needs to change the plan in order to (more quickly) reach the ultimate goal. (G16)

Of course, all this information is not available to either the Go player or to the project manager, but at least recognize the need for it, and which information is lacking.

5.2.2.2 Objectives

Next, define **<u>O</u>**bjectives that together will achieve the goal, if known, or at least advance toward the goal if it is not yet clear. This is a process. Some of the activities to develop objectives include: recognizing that change happens, so make flexible plans (G13) and be prepared to change plans when the context changes (G16), identify opportunities to take advantage of (G17), take advantage of previous activities (G18), but commit to completing each objective (G75). This last point reminds us to be careful selecting each objective – it is usually better to complete the objective than to change to a different priority without getting any value (c.f. G39). Another reminder is that particular plans are not as important as the process of planning (G77). There are generic objectives for each activity – they could be considered criteria for evaluating alternatives. Some of these criteria are: each move aligns with the goal (G01), each move benefits the goal (G02), each move helps build the goal (G04), each move is consistent with both global and local perspectives (G09) but the global perspective dominates (G05), the timing of each move should align with both global and local priorities (G36), each move has a good follow-up (G66), each move is played away from strong positions (G11), each move combines with others to make good shape (G35), each move has multiple purposes (G73), and prepares for a number of possibilities (G14), each sequence of activities produces value when it is complete (G39).

5.2.2.3 Alternatives

Consider and develop alternatives to be evaluated later in the decision process. The most obvious alternative is to continue to follow the existing plan – this is acceptable if the previous analysis determined that a change is not required. Another is to gather more information, perhaps by playing a probe in an attempt to force the opponent to decide on a course of action (G67).

Otherwise, there are a number of tactics that can be employed, e.g. attack opponent indirectly (G33, defend directly (G34), counterattack fiercely to strong opponent attack (G30), sacrifice (G59, G60), ignore and take the initiative (G61), follow, if profitable (G62), create uncertainty for the opponent (G80), maintain uncertainty as long as possible (G76), keep your groups connected and separate opponent groups (G38), if the opponent took one of two equal opportunities, take the other (G72), press to prevent the opponent achieving the goal (G31) press the opponent to achieve your goal (G32), use influence to help create value in the future (G74), find the opposition's best move – it might be the best for the project (G55).

5.2.2.4 Consequences

Identify **C**onsequences of each alternative. Read out whether it is possible to achieve each alternative (G41), and the consequences of each (G10). Analyze different sequences to find the best one (G45). Prioritize moves in reward-to-risk ratio order (G28). Plan how to exit a situation before entering it (G79).

5.2.2.5 Trade-Offs

Finally, select the best Trade-off of alternatives. Balance global and local perspectives (G06), balance risk and safety (G26), balance speed of development with stability (G29), balance planning forward and planning in reverse (G46), keep balance between player and opposition (G54), balance leading and following (G69), balance expansion and focus (G78), and finally make a decision – using the principles as guidelines, not guarantees (G81). The project manager must include other sources to make a decision, including intuition, analogy, ethics and values. To help remember the pressure of getting the decision right: each move is a lost opportunity to do something else (G37). See more on these principles in section 5.2.7 GO'S RULES.

5.2.3 Dealing with Uncertainty

Figure 9 provides a diagram of the use of Go principles for making decisions under uncertainty.

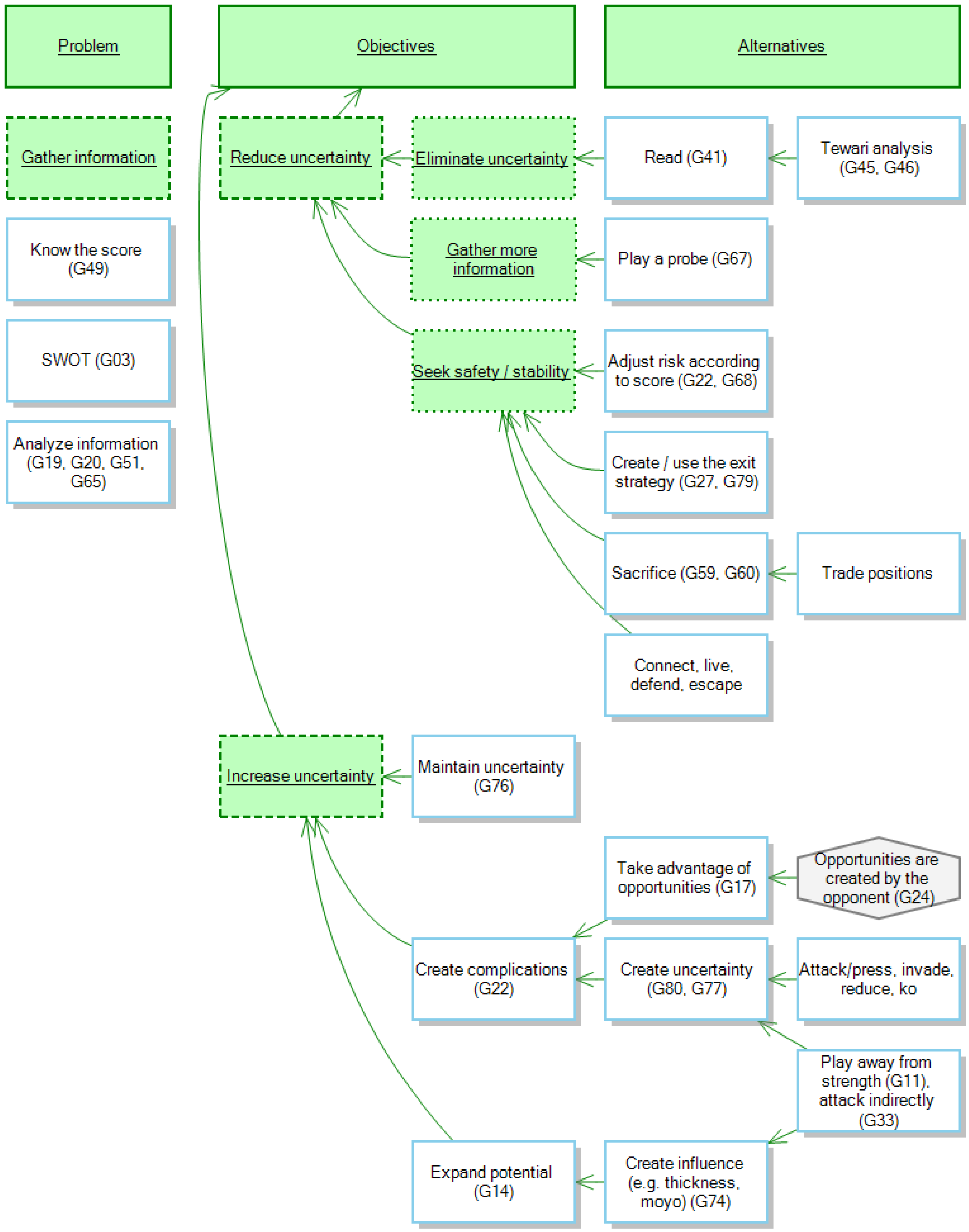

Figure 9. Dealing with uncertainty

5.2.3.1 Problem

5.2.3.1.1 Gather information

A player needs to gather information to make good decisions (G19). The starting point is to know the score (G49). The score is an estimate of the point difference between the player and opponent at the end of the game if things continue similar as they have been. A project manager always knows the status of the project, i.e. the likelihood of achieving the project goal. In project management terms, this is the "estimate at complete" from earned value analysis. These two concepts are very similar.

A player will then do a SWOT analysis (G03): identify which of each player's positions are strong and which positions are weak or can be made weak, identify open areas of the board and opportunities to weaken the opponent and to increase territory, and potential threats that the opponent can mount against the player's positions. This analysis will provide a wealth of information, but not enough. A player also analyzes the direction of play (where it is important to play next or soon) and the trajectory (what has each player been doing) (G65), and tries to identify the opponent's intentions for the future (G20, G51).

5.2.3.2 Objectives and Alternatives

There are often multiple routes to achieve an interim objective. In this section alternatives are matched to the intended objective.

5.2.3.2.1 Reducing uncertainty

A Go player generally wants to reduce uncertainty in two situations: the first is to gather information to understand the situation better in order to decide how to proceed, and the second is to minimize complications when the player is on-track to achieve the goal.

5.2.3.2.1.1 Eliminate uncertainty when the situation is knowable

A situation is knowable, in the game of Go, when a player can read to the end of a sequence of moves needed to reach an objective, taking into account the moves of the opponent. These situations are specific to the local situation / the immediate objective – not for the entire board.

> The first principle in reading is to start with a definite purpose. … Tactics must serve strategy. Start by asking yourself what you would like to accomplish in the position in question, then start hunting for the sequence that accomplishes it. … With the goal set, reading is a matter of working your way through a mental tree diagram of possible moves. You should be systematic and thorough. Start with the obvious move, followed by the obvious counter-move, the obvious counter-move to that, and so on until you have a sequence that ends in success for one side and failure for the other. Then take the last move made by the side that failed and try other possibilities. If they all fail too, go back to the same side's move before that and do the same thing again. It is important to work from the back toward the front of the sequence, to avoid leaving things out. (Davies, 1975, p. 6) (G41, G45, G46)

For example, top professionals actually read out the last 100 moves of a game because it is the most accurate method (and because they can). Near-top professionals (e.g. Michael Redmond 9P) can read about 30 moves (Garlock, 2010a). Mere mortals (e.g. amateur players) are not able to use this method.

5.2.3.2.1.2 Gather more information

One way a Go player tests the opponent's intentions is to play a probe (G67) – a move to find out how the opponent will respond in a particular situation. For example, the opponent may respond defensively, or start a fight, or may not respond but play elsewhere. On the other hand, the opponent may respond according to the way the player wanted, or may not take the bait of the probe (G67) but instead play an alternative way to mislead the original player. Probes are common in human relations, and therefore frequently used by project managers to find out what sponsor's or other stakeholder's intentions are. The project manager expects honest feedback from the project sponsor and positive stakeholders, but may treat other stakeholders' feedback with suspicion.

5.2.3.2.1.3 Seek safety

Another way of reducing uncertainty is to take steps to ensure the safety of unstable positions. A common Go proverb "Urgent before big" helps the Go player remember to fix weaknesses before starting something new. When there is a potential of significant loss, a Go player will usually take the time to consolidate the position.

A Go player, if on-track to achieving the goal, may play a move to reduce the risk of threat from the opponent – to prevent the opponent from making or creating threats against the player's significant or strategic positions (G22).

On the other hand, when the prospects for success are looking dire, then it is time to consider implementing the exit strategy developed as the situation was developing (G27, G79). This can be on a local level (e.g. sacrifice some stones) or on a large scale (e.g. resign the game or even resign from a tournament). Some of the factors to evaluate include the player's estimation of the situation, the potential for making up the difference in other parts of the board, and the skill level of the opponent (e.g. in a handicap game White will be at a significant disadvantage throughout the game). Before resigning, a player will test that the opponent has the same understanding of the situation. Once that is assured, it is probably time to resign. It is considered rude to play through to the end once both players understand that one of them no longer has a chance to win (Nakayama, 1984). In projects, it is also prudent to cut one's losses and moving on when it becomes apparent that continuing will not help achieve the project goal, and will waste resources that could be put to use elsewhere.

Go players will sometimes trade one position for another in an attempt to gain some advantage over their opponent. An extreme example of this was in the final game of the playoffs to determine the challenger for the Honinbo title in 1952 – between Sakata (White) and Takagawa (Black). During the opening Black built up strong positions on the right side – almost all of which he traded for most of the left side of the board, eventually sacrificing 23 of his first 27 moves. Trading is one of the negotiating tactics between stakeholders when a project is being proposed, but not often used once a project is approved.

A Go player may sacrifice a group of stones in order to gain something else – usually better potential to achieve the goal. Knowing the goal and knowing the score are necessary to know if sacrificing some stones or potential territory is warranted, and if so, what and how much. Weak players do not want to lose any stones/ investments. A stronger Go player is prepared to sacrifice stones in trade for something else that will help reach the goal faster (G59). This is a difficult lesson for weak players to learn because it is so difficult to keep the goal in mind at all times (G60). Giving up activities or deliverables that are part of a baseline is a significant challenge to traditional project management, but is one of the chief advantages of adaptive methods (i.e. willing to change priorities and give up sunk costs for something of higher value).

5.2.3.2.2 Increasing uncertainty

5.2.3.2.2.1 Maintain uncertainty

Not exactly increasing uncertainty, but unlike TPM Go players try to maintain uncertainty as long as possible (G76). This keeps their options open for unknown future opportunities that might develop that they might be able to take advantage of. This principle is incorporated into adaptive project management methods.

5.2.3.2.2.2 Create complications

When behind, a Go player will often increase the level of risk (and potential reward) by creating complications ("Adjust risk according to the score" (G22)) – to create opportunities for the opponent to make mistakes (G24), and then take advantage of them (G17). Some Go players can seemingly create something out of nothing. Sakata was famous for this.

Create uncertainty for the opponent (G80). There is a term in Japanese for this: *aji* (G80). Aji means "taste". It refers to a weakness or potential trouble in a position that remains after play has continued elsewhere. The principle refers to aji left in the opponent's position: a player wants to see a weakness in the opponent's position that might be able to be exploited later in the game. Frequently a player will play an extra move in the opponent's position prior to moving to another part of the board ("leave aji before leaving"). Because the aji exists, the opponent must always consider it when playing future moves – it adds to the already complex nature of the game. Therefore a player should not destroy the aji in the opponent's position by using it too early (G77). Aji is frequently used in ko fights later in the game and when exchanging territory. For examples, a project manager may insert some people into the opposition's organization, or insert a component into the opposition's product, or seed suspicions about the opposition with other key stakeholders, with the possibility of using that *aji* against the opponent later if official relations deteriorate.

Initiating a ko fight is a frequent ploy used by the player who is behind. Even though it is a fight over a single stone, that stone will typically be necessary for the leading player to maintain the lead – for example by connecting one group of stones to another. The loss of the connection may require extra stones to be played to strengthen a group, or perhaps the loss will cause an entire position to collapse. This is somewhat like negotiating over a key resource or component or deliverable in projects.

In the game of Go there are several other tactics for increasing uncertainty, e.g. attack the opposition in one area with the intention of attacking elsewhere later (G11, G33). Invading the opposition's position, reducing the opposition's area of influence, pressing the opposition into a small position. These all can be applied to project management.

5.2.3.2.2.3 Expand potential

In the early part of the game there are myriad possibilities. Because the future direction of the game is not yet known, a player should play flexible moves – ones that open up and allow a player to exploit those new possibilities (G14). In the opening in a game of Go, players stake out potential territories and potential areas of influence. In projects, this is like doing feasibility studies and the like – establishing footholds in areas of little expertise or influence.

Project managers and Go players put effort into ensuring support and learning is in place early in a project to enhance the ability of achieving their more distant objectives (G74). In the game of Go, it comes from having a group of stones with few or no weaknesses which consequently has strong influence in a particular direction (Richard Bozulich, 2001; Nam, 2004). There are four fundamental principles regarding thickness according to Bozulich (2007, p. 60):

1. Do not play near thickness (G11, G33). In the game of Go, for the player with thickness playing near the thick group would be inefficient. For the opponent, playing near thickness means that the stone will be strongly attacked. This usually refers to opening and early middle game play – it does not make much

sense later in the game because there are stones all over the place. A project manager might use this concept in a couple of ways: if the team is strong in some particular field but the project requires expertise in something else, address that new area early; or if there is an external situation which could have significant impact on the project, leave it alone until the project manager or sponsor or team have built up some support to aid in addressing the situation.

2. Do not use thickness to make territory. As briefly mentioned in the previous point, playing near thickness is inefficient. Extending from thickness requires establishing a new boundary with the opponent. This continues with the next point.
3. Use thickness to attack. If the opponent allows a player to build territory with thickness, it begins by the player playing far from the thickness, then establishing a new boundary with the opponent from there. This is very good for the player, so the opponent is unlikely to allow this to happen. The opponent will likely play from a direction in which the thickness is less helpful to reduce the usefulness of the thickness, and force the player to make relatively small territory with that thickness. The player often is able to push the invader towards the thickness from a new direction, though, establishing a new wall and new thickness in another area. This suggests that the project team use their depth of knowledge/ resources / process / whatever in a direction uncomfortable for opponents / outside stakeholders, and then build strength / depth / etc. in a new area.
4. Drive your opponent's stones in the direction of your thickness. For example, if a project requires some new technology, after ensuring that the basics of the

project are established / stable, then check out the new technology to ensure that it can be used on the project. The organization is then able to use this new expertise in new ways or for new projects or otherwise help the project or organization. If it turns out that the new technology is not appropriate, it can be treated lightly – as an investment in learning, and likely that learning can be leveraged in some way to later – e.g. by trying another new technology, or it may happen later in the project that it is appropriate to come back and give that aborted activity new life.

5.2.4 Dealing with Weaknesses

5.2.4.1 Objectives and Alternatives

After analyzing the situation and determining the problem, one objective a Go player has is to prevent further weaknesses (G22) – by playing moves that increase strength, flexibility, and resilience (G14, G35). See Figure 10.

Another objective is to ensure that the Go player's positions are no weaker than those of the opponent (G26, G54). If there are weaknesses, a Go player has a variety of strategies for dealing with them. One is to ignore the weaknesses and do something else (G61, G28); another is to sacrifice some weak stones, possibly trading them for something else (G59, G60). A third alternative is to fix the weaknesses (G07, G25) in one of a couple different ways: (1) by reinforcing the weakness (G21), possibly playing close to the opponent (G34), or (2) by attacking a weakness of the opponent's (G47), either directly or indirectly (G33). Ideally the move will serve multiple purposes (G73).

Perhaps the player does not have to analyze all these possibilities at the time of occurrence, because an exit strategy should have been prepared before even entering into a potentially dangerous situation, so it could just be executed (G27, G79).

All the above statements also apply to project management.

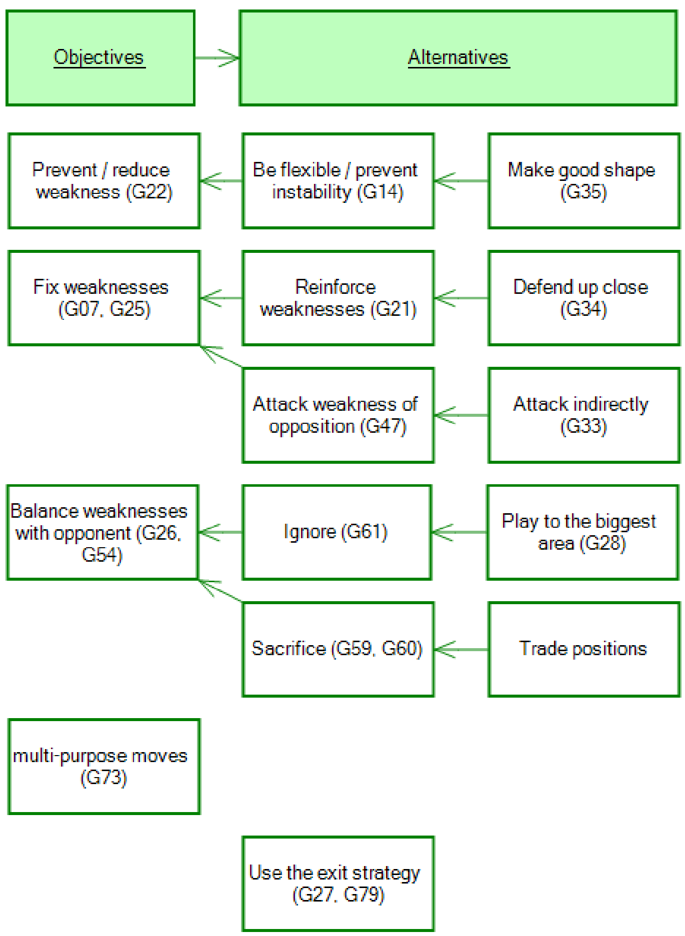

Figure 10. Dealing with weakness

5.2.5 Dealing with Conflict

Figure 11 illustrates how Go principles can be used to deal with conflict. Since there is always uncertainty regarding how to deal with conflict, those actions will also need to be used (see section 5.2.3).

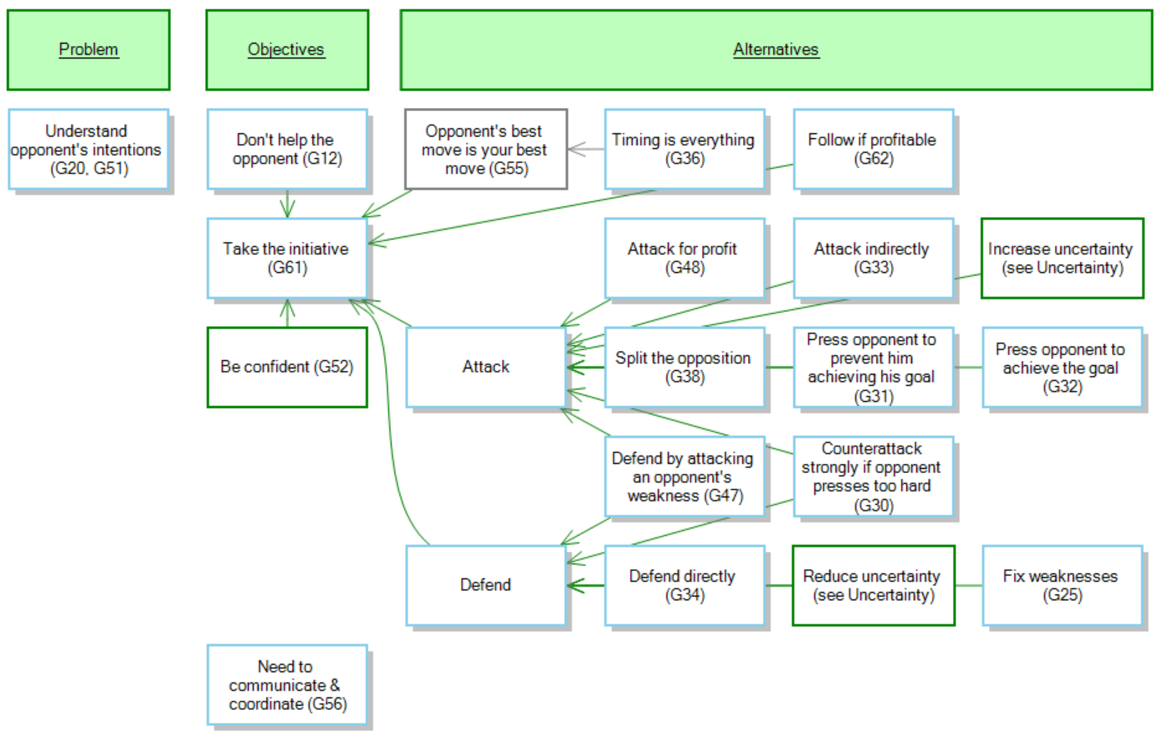

Figure 11. Dealing with conflict

5.2.5.1 Problem

When there is significant conflict, it is helpful to understand the other parties (G20, G51) – their understanding of the issues, their values, their preferences, their intentions, etc.

5.2.5.2 Objectives and Alternatives

Do not make mistakes that the opponent can take advantage of, or play in such a way that it helps the opposition more than the project (G12). This is also good advice for project managers – do not make it easy for the opposition to build its defence or to attack the project effectively.

Perhaps the most important advice for dealing with conflict is to take the initiative (G61). This requires confidence in oneself and in the project team, the sponsor, and other supporting stakeholders (G52). Sometimes the opposition makes a move that helps both parties, in which case it is okay to follow (G62) – but consciously, deliberately, and when it is the best move.

Because a player is always looking for the biggest play on the board, the opponent will often make the same assessment and play in the same place. "Your opponent's best move is your best move" (G55). A project manager needs to be always aware of the project context. If there are active opponents to the project, they may try to disrupt the project by blocking or preventing the next best set of activities. The project manager who is aware of the context can watch for these actions, and can be actively looking at other alternatives, because to find the best activities requires evaluating many other possibilities.

By playing the move the opponent wants to play, or a more valuable move, before the opponent plays it (G36) can be disheartening for the opponent, and provide a psychological advantage for the player (G70, G82, G24).

The two big categories of alternatives are attack and defend. Some of the principles for attacking the opposition are to do so indirectly (G33) – building strength somewhere else to use for a stronger attack later. This can be used in combination with pressing to prevent the opposition from obtaining the goal, and to help achieve the player's goal (G31, G32). A direct way of attacking is to split the opposition into separate, weaker parts (G38). Whatever alternative is chosen, the purpose of the attack is to gain value (G48). Other alternatives are mentioned under section 5.2.3.2.2 "Increasing uncertainty".

The other category is defence. The general rule is to defend directly (G34) or use other uncertainty reduction alternatives when necessary, such as fixing weaknesses so that the opposition does not have something to attack (G25). But preference is given to attacking an opponent's weakness which strengths the player's position (G47). If the opposition applies severe pressure against a player's weak but important group, the player is sure to try hard to defend the group and is also likely attack the opposition's surrounding groups (G30). If the opposition's surrounding groups are not strong, they may not be able to withstand the counterattack, and therefore may fall themselves. For project managers, an example of when this can apply is when there have been problems with or between contractors, or even with the sponsor or stakeholders. It is also a good idea to ensure your position is solid before taking legal action and going public.

The little bit of help that the game of Go brings to teams and organizations is the need for communication and coordination (G56). In Pair Go or other forms of playing Go in teams, communication between players on the same team is not allowed. Because of the inability to communicate each team member's perceptions and intentions to the other member(s) of the team, there is a certain amount of inconsistency and inefficiency, especially compared to a single player of similar rank, or even compared to the stronger player on the team. When the players on the team are of significantly different skill levels, then the stronger player really has three opponents: the two members of the opposing team, plus the player's own team member.

5.2.6 Dealing with Complexity

The game of Go does not deal with complexity directly; it deals with uncertainty, of which complexity is one component (Rowe, 1994).

5.2.7 GO'S RULES

The previous section included GO'S RULES as considerations when trading off alternatives, toward the end of the decision-making process. This section organizes all the Go principles using GO'S RULES. This way of thinking recommends finding the balance along each of seven dimensions and across all the dimensions to find the best way to move forward, while remembering that the rules will often not provide the best answer – the project manager is responsible for finding that.

The following subsections briefly describe GO'S RULES, and list which principles fall under which rule. Most principles interact with others so these are overlapping categories rather than strict classifications. Some principles are placed under more than one rule because they have strong application in multiple categories.

5.2.7.1 Balance Global and Local Perspectives

Find the right balance between global (big-picture / forest) and local (trees) perspectives. Recognize the impact of a myriad small/local decisions on the global perspective / on achieving the goal. The goal is not well-defined, which makes it harder to achieve because of the need to define it as you go, but easier to achieve by finding and taking advantage of new paths discovered along the way. This requires flexibility in the definition of the goal and the path to get there, which means that some efficiency will be lost compared to how the project would proceed if all information was available at the beginning. As Wildavsky (1988, p. 6) states, "there can be no stable whole without some unstable parts.". Experimental trial-and-error fits both global and local needs. At the local level, there is a well-defined objective and traditional PM methods apply. But the objective, and the knowledge and experience gained from experiments are applied to the global-level goal. Each move aligns with, builds, and benefits the goal, and is consistent with both global and local perspectives – it helps to turn a vision into reality. To ensure this, try to obtain a clear understanding of the situation (e.g. by doing a SWOT analysis), of the flow of action, and of the opponent's intentions, i.e. understand all the interactions taking place, the impact of any change on those interactions, and of those changed interactions on the project. Structures are built from interrelations. Look for and build on them (and to weaken/ cut those of opponents).

For details, see the comments in

Table 10 for principles G01, G02, G03, G04, G05, G06, G07, G08, G09, G10, G11, G12, G13, G14, G15, G16, G17, G18, G19, G20, G21, G73, and G83.

5.2.7.2 Balance Risk and Safety

Find the right balance between risk and safety. When the project status (current and projected to project end, i.e. "earned value" and "cost at completion") is good, consider taking defensive measures to prevent and/or reduce probability or impact of likely threats. When the project status is not good, consider increasing the level of risk in order to improve the odds. Perhaps use traditional project management tools (e.g. crash the schedule), or consider other possibilities (e.g. take something from, or trade with, opposition). The balance between risk and safety is dynamic – it needs to adjust to changing circumstances. So increasing risk should be considered a temporary measure. When the project status returns to a good position, then reduce the risk stance. Otherwise that risk situation (weakness) will still exist, reducing the ability of the project team to respond strongly to future changes. Choose activities with the highest reward (value) to risk ratio, i.e., that helps to achieve the project goal fastest.

Wildavsky (1988) supports principles G14, G22, G23, G24, G26, and G28. One of his main messages was that it is necessary to sacrifice something at the local level to ensure safety at the global level. This is one reason that strategy dominates tactics (G05). He also came up with the same strategies as Loch et al. (2006) for dealing with uncertainty: trial and error learning (within which they include selectionism) and planning.

> Trial and error is a device for courting small dangers in order to avoid or lessen the damage from big ones. Sequential trials by dispersed decision makers reduce the size of that unknown world to bite-sized, and hence manageable, chunks. An advantage of trial and error, therefore, is that it renders visible hitherto unforeseen errors. Because it is a discovery process that discloses latent errors so we can learn how to deal with them, trial and error also lowers risk by reducing the scope of unforeseen dangers. Trial and error samples the world of as yet unknown risks; by learning to cope with risks that become evident as the result of small-scale trial and error, we develop skills for dealing with whatever may come our way from the world of unknown risks (p.37).

One item that is implied but not explicit in traditional project management is the idea that opportunities arise from mistakes of the opposition. From a project perspective the opposition is anything that can hinder the achievement of the goal, or, using standard risk management terminology, *threats*. E.g. if the threat is passive, e.g. lack of knowledge, that passivity might be its mistake – if the knowledge is sufficiently important. If the threat is active, e.g. an obstructive vendor, that obstructiveness might be its mistake – if the project team and sponsors are willing to work with a different vendor, do the rework of starting over with a new vendor, pay the contract termination charges for the first vendor, etc.

Another item that is not frequently implemented in traditional project management is the idea of terminating doomed projects (Meredith & Mantel, 2009). Project managers should identify the criteria for terminating the project and even uncertain activities – before starting them (G27, G79).

For details, see the comments in Table 10 for principles G14, G22, G23, G24, G25, G26, G27, G28, and G79.

5.2.7.3 Balance Playing Loose and Tight

Find the right balance between speed of development (timing) and stability (good shape) to produce value. This dimension is behind many of the tactics of the game of Go.

Stability is a relative concept – relative to the opposition rather than relative to the project plan or to the goal. In the game of Go, stability means that the relations between stones forming a group are strong enough to withstand an attacked by the opposition. E.g. early in the game a single stone in a corner or along the side might be stable, but in the late midgame when a player's groups are surrounded by opponent's groups, each group needs to be obviously able to live. In projects, this might mean learning enough about a technique or process to continue the development of other deliverables, coming back to further refine the technique or process only when needed (e.g.. do not waste resources doing work on something that might be sacrificed in future).

A Go player wants to develop positions as fast as possible, while keeping threats manageable. Some players prefer a solid, steady development with the possibility of strong attacks on the opponent later, while some players prefer fast, loose development early expecting to use those early investments strategically when attacking later. Note that strong attacks are expected by both types of players, but the latter hopes to initiate the attacks first because of the fast development, and to develop them in a beneficial direction.

Every stone should be played for a reason (preferably multiple reasons), but the reason may not always include creating immediate territory. Sometimes it is to gather information (G67), sometimes to force the opponent (*kikashi*), sometimes to create uncertainty (G80)), sometimes to sacrifice in order to create value elsewhere (G59).

A strong attack from the opponent implies imbalance – the opponent is leaving weaknesses somewhere. Therefore the player should identify those weaknesses of the opponent and mount a counterattack. This principle works in the game of Go because both players are equally matched. That is not necessarily the case with a project – the opposition may be overwhelmingly strong, or very weak, or anywhere in between. The project manager needs to identify this and adjust strategy accordingly.

"Push to prevent the opponent from achieving the goal" (G31). Keep up the pressure on opponent, even when the going gets tough. When there is strong opposition to a project, fighting the opposition is just as important as fighting to complete the deliverables of the project. This is like British General Haig's famous order that his men must carry on fighting "With our backs to the wall and believing in the justice of our cause".[17]

---

[17] Douglas Haig, 1st Earl Haig. (2010). *Wikipedia*. Retrieved from http://en.wikipedia.org/wiki/Douglas_Haig,_1st_Earl_Haig

“Attack from a distance” (G33), “Defend up close” (G34), “Make good shape” (G35), and “Play away from strength” (G11) are different aspects of *ma-ai*, which means proper distance. A player places a stone at the proper distance from those around it to fulfil its purpose. This only makes sense of the stone *in relation with* other stones on the board (the player’s and the opponent’s), and *in relation with* stones that the player anticipates to be played. Proper distance is dynamic, not static. It refers to a group of stones that is flexible, strong, and resilient – all at once, and continuing into the future. Adaptive methods of project management indirectly, but not explicitly, incorporate these ideas.

A closely related concept is that of timing. Placing a stone at a particular place too early can be inefficient; too late and it may be wasted. The optimum timing for a move is difficult to choose – it has to align with both the global and the local contexts.

Another closely related idea is the power of relationships. The strongest ones are physical connections between stones, weak ones are between stones widely separated, but with no opposing stones between them, and then there is the lack of connection between groups that are separated by strong opponent positions. Maintaining connection with other stones is one of the top priorities when choosing a move, because it increases the strength of all related stones – not only those physically connected, but also those more distant because of the ability to strongly attack opponent stones that come between them. This is very much like relations between people and organizations in projects.

While Go players desire to keep all their stones connected, their opponent prevents it. So Go players must be able to manage several interrelated dynamic groups (those of their own and the constantly changing relations with each other and the opponent's groups) at the same time. Andersen (2006) uses the term 'polychronicity' for this ability. It is also related to 'selectionism' of Loch et al. (2006).

There is a term *haengma* which incorporates these ideas. It is unique to Korea, even the other Go powerhouses (Japan and China) do not have this concept. Perhaps it is part of the reason that Korean players are so strong. It views the world as dynamic, never static, always changing and evolving. It incorporates all these concepts into one word: speed of development, good shape, connections, relationship between stones, direction of play, and considering the future effect of a move before making it (based on descriptions and definitions in S.-R. Kim (2009), Nam (2004), and Yoon (2006)). Mastering this idea allows players to create strong, resilient positions quickly, allowing them to create more value than their opponent. This is precisely what project managers want to do. The Flow and Value perspectives of Koskela and Howell (2002b) are similar, although not quite as comprehensive.

For details, see the comments in Table 10 for principles: G07, G17, G29, G30, G31, G32, G33, G34, G35, G36, G37, G38, G39, G59, G76, and G82.

5.2.7.4 Balance Forward-Planning and Other Sequences of Activities

Find the right balance between efficiency and effectiveness. Be efficient, use minimal resources, reduce waste. One way to do this is to defend a position by attacking an opposition's weakness. Also remember that the purpose behind every move is to provide value – so always be aware of the status of the project and know whether it is appropriate to attack or to defend, to start something new, etc. Look for the most efficient sequence (and eliminate inefficiencies) to achieve each interim objective by ordering activities in different sequences. Plan backward from a chosen objective to find the best way forward. These principles are similar to Koskela's Flow and Value views (Koskela & Howell, 2002b) and the Taoist concept of *wu-wei*. These concepts also justify thinking when attacking or defending. Within this dimension are also some principles related to increasing competence: there is a virtuous cycle of planning and doing, encouraging the range of knowledge and experience to broaden and deepen.

For details, see the comments in Table 10 for principles G16, G33, G34, G40, G41, G42, G43, G44, G45, G46, G47, G48, G49, and G50.

5.2.7.5 Balance Between Player and Opponent

Find the right balance between how to treat "us" and "them". This starts by understanding oneself. This leads to a desire to learn and to improve, in which case a teacher / mentor /guide is usually helpful. This leads to a need to understand the opposition. Learning occurs in a cycle of learning, unlearning, and learning more deeply. This cannot be achieved without a challenge, so welcome adversity. Do not help the opposition: this can strengthen weak positions that the project team might be able to take advantage of in a different way in future, including rescuing work that had been sacrificed, or trading for something from the opposition. Multiple members on a team must communicate and coordinate to be productive and efficient as possible.

For details, see the comments in Table 10 for principles G10, G12, G38, G51, G52, G53, G54, G55, G56, G57, G58, G59, and G60.

5.2.7.6 Balance leading and following

Find the right balance between leading and following. Take the initiative as frequently as possible to achieve the project goal, but recognize that it is not wise to lead all the time. Analyze the situation at each fork in the road to choose the one most likely to lead to achieving the goal. This takes self-control and objectivity, and the willingness to take risks.

For details, see the comments in Table 10 for principles G16, G61, G62, ~~G63~~, G64, G65, G66, G67, G68, G69, and G70.

5.2.7.7 Balance Expansion and Focus

Find the right balance between expansion and focus. This complementary injunction reminds us to focus on, and commit to achieving, clear objectives when the situation is clear, e.g. use deterministic planning for short-term objectives. But when the situation is not clear, this principle reminds us that flexible, multi-purpose actions are best to prepare for and to adapt to changing situations. The act of planning, e.g. considering pros and cons and assumptions of various alternatives, provides us with pre-analyzed alternatives when conditions change, allowing for faster decision-making. Before embarking on a particular course of action, prepare an exit strategy – in case things do not go as expected. In conditions of uncertainty, influence is helpful – using others to help create value in the future. Maintain, or even increase, the level of uncertainty in some situations, e.g. when behind (take bigger risks for potential of bigger gain), when the opposition is struggling with uncertainty (wait for the opposition to make mistakes and the take advantage of them)

For details, see the comments in Table 10 for principles G14, G39, G71, G72, G73, G74, G75, G76, G77, G78, G79, and G80.

5.2.7.8 Take Responsibility to Find the Best Decision for Every Decision

Finding the appropriate balance of the above principles will usually provide a good decision, and should be followed if nothing better is available. But these are not all the aspects that need to be considered when making a decision. Even though there is usually insufficient information to make a rational decision, knowing the goal provides one more guideline. The project manager bears the responsibility of achieving the project goal, so has the responsibility for determining which alternative to follow in any situation. Therefore the project manager should strive to make the best decision, every time a decision is required.

For details, see the comments in Table 10 for principles G81, G82, and G83.

5.3 Project Manager

We have just seen that projects are dynamic, temporary entities with lives of their own.

So, what does it take to manage such a project? One way to answer the question is to describe a project manager like a Go player.

5.3.1 *Characteristics of a Project manager*

Based on an analysis of the Go principles, a good Go player (aka "project manager") requires the following traits: objective, self-controlled, self-confident, perceptive, committed, driven, comfortable with uncertainty and conflict, strives for perfection, and desires to continue to learn. This practice enhances creativity, ability to consider several interrelated things at once, decision-making, and leadership skills.

5.3.1.1 Objective

A project manager has to objectively evaluate the situation on an ongoing basis. There is no room for wishful thinking. A project manager deals with the current situation – not an imaginary one. If mistakes have been made – accept them, evaluate the situation, and look for new ways to reach the goal since the old plan will not likely work anymore. An objective evaluation of the situation and objective assessment of alternatives for moving forward have a higher chance of success than any other approach. Consider the situation from the others perspectives (see Perceptive), then identify the best ways to disrupt the opposition and put plans in place to deal with those potential threats. (G01, G03, G19, G49, G64, G83)

5.3.1.2 Self-Controlled

Project managers need to control their thinking and emotions. It is easy to become over-optimistic when things are going well, and it is easy to get depressed when things are going badly (e.g. based on the perception of opposition's intentions). It takes self-control to look for the best move, every move. Be patient – wait for the opposition to make a mistake. (G24, G70, G82)

5.3.1.3 Self-Confident

The project manager must be confident in the ability of the team to achieve each objective and ultimate the project goal. Doubts will result in being too conservative when making decisions about the best actions to take. The result will be missed opportunities and inefficiency, and self-fulfilling prophecy reducing the ability to achieve the goal. (G52)

5.3.1.4 Perceptive

The project manager needs to consider the project from all perspectives. Try to understand the motives for the actions of each of the stakeholders. Are they acting rationally? Are they making mistakes? What are their goals? What would be best for them to do to achieve their goals? How can they disrupt the project? Can they be allies? (G20, G51)

5.3.1.5 Committed

A player analyzes the situation on the board and the trajectory of play, considers a number of potential objectives to reach the goal, reads through the most promising ones (including likely obstacles) and, after reviewing the anticipated outcome after reaching each objective, chooses one. After deciding which alternative has the highest probability of reaching the goal, plays according to that line of thinking. That line is followed as long as possible – deviating only if a new, highly lucrative opportunity presents itself or if the opponent mounts an unforeseen counterattack. Obstacles that come up, whether anticipated or not, are quickly checked after each opponent's move to ensure that the current objective is still appropriate. (G75)

5.3.1.6 Driven

The project manager must drive self and team to reach each objective and the final goal. Ignore, push through, dodge, remove, or go around all obstacles in the path to the objective. But not blindly – if the objective cannot be reached, then it is time to try something else. But until that has been established, keep pushing. Do not leave any weaknesses for the opposition to exploit, but exploit weaknesses in the opposition if they can help achieve the goal. This requires teamwork and creativity in addition to drive. (G27, G31, G32, G24, G41)

5.3.1.7 Comfortable with Uncertainty and Conflict

> To stay with conflict, all of us… need to develop the capacity to deal with several dimensions of uncertainty or irresolution. We need to develop the capacity to live with
>
> - anxiety …
> - moral ambiguity …
> - emotional turmoil …
> - identity confusion …
> - cognitive dissonance …

- intellectual uncertainty …

> Individuals involved in a long-term struggle need to develop the capacity to live with these paradoxes and uncertainties. Moreover, they need to accept these dilemmas without sacrificing their commitment, involvement, or energy. This is no easy task. No one is continually capable of living with these ambiguities while maintaining his or her courage and focus. …
>
> In order to stay with conflict effectively, people need energy and motivation to sustain them, and these vital resources are fostered by moral certainty and a polarized framing of the conflict. But in order to remain constructive in the face of enduring conflict, people also need to challenge such sustaining certainties and polarities. (Mayer, 2009, pp. 36-37)

5.3.1.8 Strives for Perfection

Go players know that the game is not solved (from a game theory perspective). Even top professional players recognize there is so much more to learn that they say they know nothing of the game (Nakayama, 1984, p. 79). These top players strive to find the best move for every move during a game. They know that the principles are generally good – but are not necessarily best for any particular situation. They analyze even seemingly simple situations to ensure they have not overlooked some potential opportunity or weakness. This spirit of striving, struggling, grasping is required of top players (Terry, 1987), and to a lesser degree for all Go players intent on improving their play (Rin, 2001). (G81, G82)

I have not met a project manager with the degree of passion I've seen in many Go players. Most are "accidental" project managers – it is a part-time part of their regular job, not their career (Darrell, Baccarini, & Peter, 2010). I think this says a lot about the probability of success for many projects.

5.3.1.9 Learning

The project manger is always learning. Recognizing a positive feedback loop that includes learning to plan, which helps to improve the ability to plan, to improve efficiency, to anticipate the opposition's actions, to take advantage of anticipated difficulties, and to find better ways of planning in future, all of which help to improve the competence of the project manager, and so continues to learn, and so on and so on… The project manager also recognizes that there is a negative feedback loop – weaknesses are more exposed the longer they are not fixed. But learning has a price – new skills needs to be practiced in new and progressively more difficult situations (i.e. projects), which means taking risks, which sometimes lead to failure – in which case the lesson is usually especially well-learned. Even the very best professional Go players have winning percentages of less than 80% in a given year, e.g., (Power, 2009). A teacher / mentor can help reduce the risk and increase the speed of learning. Skill is developed in three levels: first by learning and practicing the basics, then by challenging one's comfort zones by adding new tools and techniques, and finally by developing one's own style which the project manager adapts to the situation. Each level requires unlearning some aspects of the knowledge previously gained so that it can be learned in more depth. This means that those three levels repeat as well. This learning cycle requires self-reflection – being a reflexive practitioner (Cooke-Davies et al., 2007; Jaafari, 2003). This in turn requires self-control. (G07, G08, G23, G40, G41, G42, G43, G44, G53, G56, G57, G58, G68)

5.3.1.10 Leadership

A popular leadership writer and speaker in Canada, Doug Keeley, claims that leadership is vision, belief, commitment, passion, and courage, built on a foundation of accountability and action. (Keeley, 2007, p. 12). Every one of these characteristics (using descriptions from his book) has a related Go principle:

1. Leaders are accountable for themselves and their results (The player is responsible for all decisions (G82))
2. Leaders take action (Take the initiative (G61))
3. Leaders have a vision of the future - where they want to be and what they want to do (Know the goal (G83))
4. Leaders believe in themselves and what they are trying to do (Build and have confidence in your own ability (G52))
5. Leaders are committed, they persevere (Push the opponent to achieve the project goal (G32)) and Commit to completing each objective (G75))
6. Leaders are passionate, they believe in and love what they do (Always do your best (G82))
7. Leaders have courage: making tough calls, going outside their comfort zone, doing things that have not been done before, taking risks. (Take risks to gain competence (G23)) and (Take risks, fail, and learn from those failures (G44))

Based on this, playing Go can help develop leadership skills.

5.4 Limitations and Constraints

5.4.1 Limitations of the Analogy

The game of Go does not address some areas that are part of project management. These are primarily in the areas of organizations and human relations. For example, the game of Go has nothing to help choose between a weak matrix, strong matrix or project-oriented organizational structure. A project manager has to consider the pace and relationship of the project with the larger organization, whereas a game of Go is independent of other games, except as part of a tournament (but that is not a useful analogue in this situation). Turner identifies several roles in project management along with their respective responsibilities, and two of these really have no analogue in the game of Go: the users who operate the asset on the owner's behalf, and sponsors who channel resources to the project on the owner's behalf. Similarly, the Go player does not have the responsibility to choose team members, structure steering committees, or choose a leadership style – as project managers do. The Go player does not have to keep and sell the vision, communicate plans and status, or negotiate with other parts of the organization for resources: the Go player has access to a pool of as many equal-valued resources (stones) as is required, unlike a project manager who has limited resources of a variety of types. The Go player also does not have to deal with the psycho-social aspects of dealing with humans, e.g. tempers, fears, ambitions, etc.: players only have to deal with themselves and their opponent.

5.4.2 Limitations of Analogy

Itkonen (2005, p. 63) identifies a limitation of analogy that affects this thesis (PM is like the game of Go) and so must be dealt with: that similarity is not analogy. He uses the example that there can be an analogy between a bird and a fish, but not between two birds (although there is a grey area, e.g. if comparing a sparrow and an ostrich). In this research, a game of Go is not only *like* a project, but a game of Go *is* a project. I believe this research falls into the grey area for two reasons: 1) using a broad definition of project allows one to say "all work is project work" (Laufer, 2009, p. 1), and a game of Go is a project only with some of the broader definitions. For example, it does not stand up to the definition of project used by Turner and Müller (2003) or by Andersen (2006) because it is not a temporary organization using their definition. 2) A Go player who uses traditional project management methods would quickly lose every game. So if a game of Go is a project, treating it like a project will result in failure. It follows that either the game of Go is not just a project, or that traditional project management methods are insufficient to cover this type of project. Itkonen (2005) supports this point by also saying that a limitation to these limitations is if the purpose of the analogy is learning, because all learning is analogical.

5.5 Summary

Projects are the tools to implement organizational strategies. Strategy poorly executed is wasted. Organizations in Asia have long recognized that the game of Go teaches this praxis, so they encourage their staff to become adept at the game (Shotwell, 2003, p. 166).

Go players develop attitudes, behaviours and skills that are directly transferrable and applicable to project management. The game of Go teaches many of the skills to successfully achieve project and organizational goals.

6 Conclusion

In Chapter 1 the need for new ideas and new concepts for managing projects was identified from several authors. This work has advanced a new perspective of project management – from the game of Go. It has demonstrated how the game of Go varies from traditional project management regarding uncertainty, complexity, change, conflict, and multiple goals. In particular, it has suggested an integrated process for managing projects exhibiting these characteristics. It further suggested some characteristics of managers for these types of projects. This research has added to the field of project management the need to consider managing conflict as a permanent condition (enduring conflict) in addition to treating it like a temporary situation that can be avoided or resolved. This research also provides value by promoting and illustrating the use of analogy for project managers and stakeholders.

6.1 Summary

This research demonstrated, using analogy, that project management is like the game of Go and that many Go principles can be applied to project management.

The research questions were:

1. What can we learn about the nature of projects from the game of Go?
2. What can we learn about managing these types of projects from the game of Go?
3. What kind of person can manage these types of projects?

This research views projects primarily as complex problems. These types of projects have a purpose; are unique, complex and complicated; exist within a larger context; change frequently; deal with conflict and with uncertainty of various types, including unclear definition of the goal and insufficient or unreliable information needed to make decisions.

Project management based on principles from the game of Go incorporates both positivist and constructivist perspectives. It is positivist in the short-term, when short-term objectives can be identified (but aligned with higher-level goals), conforming to Winch (2004)'s description (substituting "project" with "objective") as being "deterministic, it assumes that the scope of the objective is completely knowable in advance; that an appropriate plan can be developed to deliver that scope; and that the problem of control is simply to keep the objective delivery to plan. … decision-making under uncertainty presumes that the complete range of possible outcomes can be specified in advance." However, these periods of apparent lucidity and stability are temporary and possibly false; the overall context is one of continuous change, complexity, conflict, and uncertainty where none of the positivist assumptions mentioned above hold true. For these conditions a constructivist approach, with a focus on relationships, assuming a transformative teleology and using techniques such as experimental learning, second-order control, and intuition-based decision-making, is more appropriate.

Some concepts from the game of Go that are not well-developed in project management are:

1. Nothing is permanent – everything is changing. This is closely related to the next two concepts.
2. Everything is connected. Although every change changes everything, each change impacts different areas differently. Understanding the value of relationships at any point in time and as they may change in the future is required in order to understand how to deal with each change.
3. Some conflict is enduring. As a consequence, managing projects means constantly struggling, e.g. pushing against the opposition, especially when its success implies project failure. Another consequence is that the project must be flexible, resilient and robust enough to handle the changes and uncertainty in the project environment. This implies the need to adapt quickly to changes, including both reducing and increasing the amount of uncertainty. It also implies that the stability of the whole depends on instability of some parts (i.e. there will be a need to sacrifice something).
4. Success occurs *only* by finding and exploiting opportunities - which are created by opposition's mistakes and changes of perspective.
5. Project managers continuously and iteratively measure and evaluate progress to plans and goals, are prepared to modify both plans and goals, and to adjust actions as necessary.

A significant aspect of managing projects is making decisions, and the Go principles in this research can be used when making decisions – under conditions of uncertainty, risk, conflict and certainty. This research used 83 low-level Go principles, but they can be compressed to the eight GO'S RULES: Balance global and local perspectives (G06), balance risk and safety (G26), balance speed of development with stability (G29), balance planning forward and planning in reverse (G46), balance between the player and the opposition (G54), balance leading and following (G69), balance expansion and focus (G78), and there are no rules (G81).

Go players and successful managers of complex problem projects are objective, self-controlled, self-confident, perceptive, committed, driven, creative; they strive for perfection, continue to learn, and are comfortable with uncertainty and conflict. They continually enhance their leadership skills, their ability to consider several interrelated things at once, and their ability to make decisions.

In short – Go players develop attitudes, behaviours and skills that are directly transferrable and applicable to project management. Learning and playing the game of Go can help project managers become even more competent project managers.

This research also explains and gives examples for using analogy to import knowledge from other fields appropriately.

6.2 Value of the Research

This research adds value to the field of project management in the following ways.

This research adds to project management theory by:

1. Providing a different perspective on projects, project management and project managers – from the perspective of the game of Go (and summarised above).

2. Demonstrating the use of analogy for incorporating ideas, theories, etc. from other fields (in this case the game of Go) to project management.
3. Demonstrating that the game of Go and project management are types of complex problem solving, therefore tools used in one of these three fields have a reasonable chance of being applicable in the other fields.
4. Providing a way to incorporate traditional and adaptive (or positivist and constructivist) project management approaches into one, able to deal with decision-making under uncertainty, risk, certainty and conflict.
5. Recognizing enduring conflict as a characteristic of complex problem projects.
6. Adding to the research on decision-making in project management.
7. Supporting iterative project management approaches that focus on relationships (e.g. adaptive, agile, extreme, complex).
8. Demonstrating that traditional project management methods can work in situations of high change but low uncertainty.
9. Demonstrating that adaptive project management methods are appropriate for higher levels of uncertainty.

This research adds to the practice of project management by:

1. Identifying some characteristics to look for when selecting a project manager for a complex problem project.
2. Providing a decision-making framework and considerations to assist project managers (and governing bodies such as sponsors and steering committees) when making decisions.

3. Providing a safe, fun way to improve the competence of project managers, i.e. the game of Go.

6.3 Suggestions for Further Research

This research provides the foundation for additional work, such as:

1. There were 40 analogies that yielded inferences are not yet common practice in project management. More research could help understand why they are not yet common practice, and perhaps encourage them to be adopted.
2. Further explore the combined dynamic of uncertainty, change, and enduring conflict.
3. Explore the subjective (i.e. moral and rule) aspects of uncertainty in project management decision-making.
4. Explore cultural influences on project management. For example: Are there different cultural biases as suggested by Pinckard (2001b) when he referred to the games of chess, backgammon and Go, and are they manifested in different ways of managing projects?
5. The Go principles were put into predicate logic format. This format is sometimes used for incorporating domain knowledge into "Artificial Intelligence" computer programs. It would be interesting to do so and try it out on some project management situations to see if it can propose good solutions to them.
6. Combine this research with others' work (e.g. Bredillet (2004b), Cicmil et al. (2009), Koskela and Howell (2002b), Saynisch (2010b), and J. R. Turner (2007a)) to continue to develop the theoretical foundation for project management.

7. Develop or explain theories of project management using other theories, e.g. game theory, complexity theory, general systems theory, complex problem solving, conceptual spaces, or complex responsive processes of relating (CRPR).
8. Apply Go principles to portfolio management.
9. Develop a project management methodology based on Go principles.
10. Find and incorporate more Go knowledge (e.g. from Chinese and Korean sources) to provide a broader, deeper basis for this research.
11. Validate this research by exploring whether, to what extent, and when, Go-playing project managers use Go-based perspectives (e.g. when planning and managing projects or when reflecting on their practice).

References

Agassi, J. (1988). Analogies hard and soft. In D. H. Helman (Ed.), *Analogical reasoning: Perspectives of artificial intelligence, cognitive science, and philosophy* (pp. 401-419). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Aguanno, K. (Ed.). (2004). *Managing agile projects*. Lakefield, ON: Multi-Media Publications.

Alexander, C. (1964). *Notes on the synthesis of form*. Cambridge, MA: Harvard University Press.

Allis, L. V. (1994). *Searching for solutions in games and artificial intelligence.* Doctoral thesis, University of Limburg, Maastricht. Retrieved from http://fragrieu.free.fr/SearchingForSolutions.pdf

Ambler, S. (2004). The heightened Importance of communications. In K. Aguanno (Ed.), *Managing agile projects* (pp. 159-164). Lakefield, ON: Multi-Media Publications.

American Go Association. (2010). Go in print Retrieved October 4, 2010, from http://www.usgo.org/resources/books.html

Anbari, F., Anderson, J., Brewster, D., Brito, L. B., Counterman, D., & Jones, E. (2005). *Superconducting Super Collider project*. Newtown Square, PA: Project Management Institute.

Anbari, F., Critten, D., Deneny , T., Goculdas, K., Pottruff, K., & Ruiz, J. (2006). *The Mars Pathfinder project*. Newtown Square, PA: Project Management Institute.

Anbari, F., Giammalvo, P., Jaffe, P., Letavec, C., & Merchant, R. (2005). *The Chunnel project*. Newtown Square, PA: Project Management Institute.

Andersen, E. S. (2006). Toward a project management theory for renewal projects. *Project Management Journal, 37*(4), 15-30.

Anderson, D., Augustine, S., Avery, C., Cockburn, A., Cohn, M., DeCarlo, D. et al. (2005). Declaration of interdependence. Retrieved from http://pmdoi.org/

Anderson, T. (2004). *The way of go: 8 ancient strategy secrets for success in business and life*. New York: Free Press.

Archibald, R. D. (2003a). *Managing high-technology programs and projects* (3rd. ed.). Hoboken, NJ: John Wiley & Sons.

Archibald, R. D. (2003b). State of the art of project management: 2003. Retrieved from http://www.pmforum.org/library/papers/index.htm

Argyris, C., & Schon, D. (1978). *Organizational learning: A theory of action perspective*. Reading, MA: Addison-Wesley.

Ashley, K. D. (1988). Arguing by analogy in law: A case-based model. In D. H. Helman (Ed.), *Analogical reasoning: Perspectives of artificial intelligence, cognitive science, and philosophy* (pp. 205-224). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Ashworth, E. J. (2004). Medieval theories of analogy. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosphy* (Winter 2004 ed.). Retrieved from http://plato.stanford.edu/archives/win2004/entries/analogy-medieval/.

Association for Project Management. (2006). *APM body of knowledge* (5th ed.). High Wycombe, UK: Author.

Atkinson, R., Crawford, L., & Ward, S. (2006). Fundamental uncertainties in projects and the scope of project management. *International Journal of Project Management*, *24*(8), 687-698.

Aubusson, P. (2002). Using metaphor to make sense and build theory in qualitative analysis. *The Qualitative Report*, *7(4)*. Retrieved from http://www.nova.edu/ssss/QR/QR7-4/aubusson.html

Avis, W. S., Drysdale, P., Gregg, R. J., Neufeldt, V. E., & Scargill, M. H. E. (Eds.). (1983) Gage Canadian dictionary. Toronto, ON: Gage.

Awaji, S. (2007). *Changing one's conceptions: Awaji's aphorisms*. Libertyville, IL: Hinoki Press.

Bacon, F. (1620). The new Organon J. Bennett (Ed.) Retrieved from http://www.earlymoderntexts.com/pdf/baconewo.pdf

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M. et al. (2001). Manifesto for agile software development. *Agile Alliance*. Retrieved from http://agilemanifesto.org/

Blech, C., & Funke, J. (2010). You cannot have your cake and eat it, too: How induced goal conflicts affect complex problem solving. *Open Psychology Journal, 3*, 42-53. doi: 10.2174/1874350101003010042

Blomquist, T., Hallgren, M., Nilsson, A., & Soderholm, A. (2010). Project-as-practice: In search of project management research that matters. *Project Management Journal, 41*(1), 5-16.

Bluedorn, A. C., Kalliath, T. J., Strube, M. J., & Martin, G. D. (1999). Polychronicity and the inventory of polychronic values (IPV): The development of an instrument to measure a fundamental dimension of organizational culture. *Journal of Managerial Psychology*, *14*(3/4), 26.

Boehm, B., & Turner, R. (2004). *Balancing agility and discipline: A guide for the perplexed*. Boston, MA: Addison-Wesley.

Boorman, S. A. (1969). *The protracted game: A wei-ch'i interpretation of Maoist revolutionary strategy*. New York: Oxford University Press.

Borella, J. (2000). *Penser l'analogie*. Geneva: Ad Solem.

Bourgault, M., Drouin, N., & Hamel, E. (2008). Decision making within distributed project teams: An exploration of formalization and autonomy as determinants of success. *Project Management Journal*, *39*(Special PMI Research Conference Edition), S97-S110.

Bouzy, B., & Cazenave, T. (1996). Shared concepts between complex systems and the game of Go. Retrieved from http://www.lamsade.dauphine.fr/~cazenave/papers/shared96.pdf

Bozulich, R. (1987). *The second book of go*. Mountain View, CA, USA: Ishi Press International.

Bozulich, R. (1992). *The go player's almanac*. Tokyo: Ishi Press.

Bozulich, R. (2002). *Five hundred and one opening problems*. Tokyo: Kiseido Publishing Company.

Bozulich, R. (2007). *The basics of go strategy*. Tokyo: Kiseido Publishing Company.

Bozulich, R. (Ed.). (2001). *The go player's almanac 2001* (Second ed.). Tokyo: Kiseido.

Bradley, M. N. (2006). *New go proverbs illustrated*. Santa Monica, CA: Yutopian.

Bredillet, C. (2002). Killing the false gods of project management. Retrieved from http://www.pmforum.org/library/papers/2002/fasegods_bredillet%20.pdf

Bredillet, C. (2004a). *Beyond the positivist mirror: Towards a project management 'gnosis'*. Paper presented at the IRNOP IV Conference, Turku, Finland.

Bredillet, C. (2004b). *Theories & research in project management: Critical review and return to the future.* Doctoral thesis, ESC-Lille, Lille, France.

Bredillet, C. (2004c). *Understanding the very nature of project management: A praxiological approach*. Paper presented at the PMI Research Conference, London, UK.

Bredillet, C. (2007a). Exploring research in project management: Nine schools of project management research (Part 1). *Project Management Journal*, *38*(3), 3-4.

Bredillet, C. (2007b). Exploring research in project management: Nine schools of project management research (Part 2). *Project Management Journal*, *38*(3), 3-5.

Bredillet, C. (2007c). Exploring research in project management: Nine schools of project management research (Part 3). *Project Management Journal*, *38*(4), 2-4.

Bredillet, C. (2008a). Exploring research in project management: Nine schools of project management research (Part 4). *Project Management Journal*, *39*(1), 2-6.

Bredillet, C. (2008b). Exploring research in project management: Nine schools of project management research (Part 5). *Project Management Journal*, *39*(2), 2-4.

Bredillet, C. (2008c). Exploring research in project management: Nine schools of project management research (Part 6). *Project Management Journal*, *39*(3), 2-5.

Bredillet, C. (2008d). Learning and acting in project situations through a meta-method (MAP) a case study: Contextual and situational approach for project management governance in management education. *International Journal of Project Management*, *26*, 238-250.

Bredillet, C., Turner, J. R., & Anbari, F. T. (2007, June 18-20). *Schools of thought in project management research.* Paper presented at the 21st IPMA World Congress: Project Management Essential Reality for Business and Government, Krakow, PL.

Bryant, J. (2010). The role of drama theory in negotiation. In D. M. Kilgour & C. Eden (Eds.), *Handbook of group decision and negotiation* (pp. 223-245). New York: Springer.

Burmeister, J. (2000). *Studies in human and computer go: Assessing the game of go as a research domain for cognitive science.* Doctoral dissertation, University of Queensland, Brisbane.

Burrell, D. (1973). *Analogy and philosophical language*. New Haven: Yale University Press.

Byrne, J. J. (2011). *Polaris: Lessons in risk management*. Oshawa, ON: Multi-Media Publications.

Carlton, D. (2007). Annotated go bibliographies Retrieved March 12, 2011, from http://www.gobooks.info/

Caupin, G., Knoepfel, H., Koch, G., Pannenbäcker, K., Pérez-Polo, F., & Seabury, C. (Eds.). (2006). *ICB - IPMA competence baseline 3.0*. Nijkerk, The Netherlands: International Project Management Association.

Chalmers, D., French, R., & Hofstadter, D. R. (1995). High-level perception, representation, and analogy: A critique of artificial-intelligence methodology. In D. R. Hofstadter (Ed.), *Fluid concepts & creative analogies: Computer models of the fundamental mechanisms of thought*. New York: Basic Books.

Chapman, C., & Ward, S. (2002). *Managing project risk and uncertainty: A constructively simple approach to decision making*. Chichester, UK: Wiley & Sons.

Cho, C. (1997). *Go: A complete introduction to the game*. Tokyo: Kiseido.

Cicmil, S., Cooke-Davies, T. J., Crawford, L., & Richardson, K. A. (2009). *Exploring the complexity of projects: Implications of complexity theory for project management practice*. Newtown Square, PA: Project Management Institute.

Cicmil, S., & Hodgson, D. (2006). New possibilities for project management theory: A critical engagement. *Project Management Journal, 37*(3), 111-122.

Cleland, D. I., Bursic, K. M., Puerzer, R., & Vlasak, A. Y. (Eds.). (1998). *Project management casebook*. Sylva, NC: Project Management Institute.

Cleland, D. I., & Ireland, L. R. (2007). *Project management: Strategic design and implementation* (5th ed.). New York, NY: McGraw-Hill.

Cleland, D. I., & Ireland, L. R. (2010). *Project manager's portable handbook* (Third ed.). New York, NY: McGraw-Hill.

Cockburn, A. (2001). *Agile software development* (1st ed.). Upper Saddle River, NJ: Addison-Wesley.

Connelly, M. (1996, March 2, 2004). Critical thinking core concepts: Using and criticizing analogies in premises. *Critical thinking across the curriculum project MCC Longview* Retrieved November 11, 2005, from http://mcckc.edu/services/criticalthinking/corenotes/otherinfo.asp

Conway, J. H. (1976). *On Numbers and games*. New York: Academic Press.

Cooke-Davies, T. J., Cicmil, S., Crawford, L., & Richardson, K. A. (2007). We're not in Kansas anymore, Toto: Mapping the strange landscape of complexity theory, and its relationship to project management. *Project Management Journal, 38*(2), 50-61.

Council for a Parliament of the World's Religions. (1993). Declaration toward a global ethic. Chicago, IL: Council for a Parliament of the World's Religions.

Courtney, H., Kirkland, J., & Viguerie, P. (1997). Strategy under uncertainty. *Harvard Business Review, 75*(6), 67-79.

Crawford, L., Hobbs, J. B., & Turner, J. R. (2002). *Investigation of potential classification systems for projects*. Paper presented at the PMI Research Conference, Seattle, WA, USA.

Creasey, T., & Hiatt, J. M. (Eds.). (2009). *Best practices in change management* (2009 ed.). Loveland, CO: Prosci.

Daniel, P. (2007). *Dynamic systems management methodology [PDF document]*. Course presentation. CIMAP. Lille.

Darden, L., & Rada, R. (1988). Hypothesis formation using part-whole interrelations. In D. H. Helman (Ed.), *Analogical reasoning: Perspectives of artificial intelligence, cognitive science, and philosophy* (pp. 341-375). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Darrell, V., Baccarini, D., & Peter, E. D. L. (2010). Demystifying the folklore of the accidental project manager in the public sector. *Project Management Journal, 41*(5), 56-63. doi: 10.1002/pmj.20164

Davies, J. (1975). *Tesuji*. Tokyo: Ishi Press.

De Meyer, A., Loch, C. H., & Pich, M. T. (2002). Managing project uncertainty: From variation to chaos. *MIT Sloan Management Review, 43*(2), 60-67.

DeCarlo, D. (2004). *eXtreme project management: Using leadership, principles, and tools to deliver value in the face of volatility*. San Francisco, CA: Jossey-Bass.

Declerck, R. P., & Eymery, P. (1976). *Le management et l'analyse des projets: Description de la methode MAP et cas d'application* (langue francaise ed.). Suresnes, France: Hommes et Techniques.

Deemer, P., & Benefield, G. (2008). Scrum primer. In J. Sutherland & K. Schwaber (Eds.), *The scrum papers: Nut, bolts, and origins of an agile framework*. Boston, MA: Scrum Training Institute.

Defence Materiel Organisation Australia. (2008). *Complex project manager competency standards V3.3*. Deakin, AU: International Centre for Complex Project Management.

DeFillippi, R. J., & Arthur, M. B. (1998). Paradox in project-based enterprise: The case of film making. *California Management Review, 40*(2), 125-139.

Deguire, M. (2006). *A theoretical decision making continuum for projectized environments*. Paper presented at the PMI Research Conference, Montreal.

Dinsmore, P. C., & Cooke-Davies, T. J. (2006). *The right projects done right! From business strategy to successful project implementation*. San Francisco, CA: Jossey-Bass.

Dombkins, D. H. (2007). *Complex project management: Seminal essays by Dr. David H. Dombkins*. North Charleston, SC: BookSurge Pulishing.

Douglas III, E. E. T. (1996). The end game - Project demobilization and close-out. *Trasactions of AACE International*, CS71-CS74.

Douglas III, E. E. T. (1998). The opening game - Project mobilization. *AACE International Transactions*, PS8-PS12.

Dreyfus, H., & Dreyfus, S. (2005). Expertise in real world contexts. *Organization Studies, 26*(5), 779-792.

Dreyfus, S. (2004). The five-stage model of adult skill acquisition. *Bulletin of Science, Technology & Society, 24*(3), 177-181.

Dvir, D., & Lechler, T. (2004). Plans are nothing, changing plans is everything: The impact of changes on project success. *Research Policy, 33*(1), 15.

Fairbairn, J., & Hall, T. M. (2009). *The go consultants: Suzuki Tamejiro and Segoe Kensaku against Kitani Minoru and Go Seigen*. Richmond, VA: Slate & Shell.

Fairbairn, J., & Hall, T. M. (2010). Games of go on disk (GoGoD) [DVD] (Winter 2010 ed.). London: Author.

Farjoun, M. (2008). Strategy making, novelty and analogical reasoning - Commentary on Gavetti, Levinthal, and Rivkin (2005). *Strategic Management Journal, 29*, 1001-1016.

Fernandez, D., & Fernandez, J. (2008). Agile project management - Agilism versus traditional approaches *The Journal of Computer Information Systems, 49*(2), 10.

Fisher, R., Ury, W., & Patton, B. (1991). *Getting to yes: negotiating agreement without giving in* (2nd ed.). New York: Penguin Books.

Forbes, B. C. (1921). Why do so many men never amount to anything? Thomas A. Edison, the great inventor, answers this pointed question. *American Magazine, 91,* 10-11, 85-86, 89.

Fotland, D. (1996). What is the game of go? Retrieved December 7, 2010, from http://www.usgo.org/resources/whatisgo.html

Fowler, J. (2005). *An introduction to the philosophy and religion of Taoism: pathways to immortality*. Brighton, UK: Sussex Academic Press.

Frame, J. D. (2002). *The new project management: Tools for an age of rapid change, complexity, and other business realities* (2nd ed.). San Francisco, CA: Jossey-Bass.

Frensch, P. A., & Funke, J. (1995). Definitions, traditions, and a general framework for understanding complex problem solving. In P. A. Frensch & J. Funke (Eds.), *Complex problem solving: The European perspective* (pp. 3-25). Hillsdale, NJ: Lawrence Erlbaum Associates.

Frensch, P. A., & Funke, J. (2002). Thinking and problem solving. *Encyclopedia of life support systems*. Retrieved from http://www.ub.uni-heidelberg.de/archiv/8238

Fujisawa, S. (2004). *Dictionary of basic tesuji: Tesuji for attacking* (S. Bretherick, Trans. Vol. 1). Richmond, VA: Slate & Shell.

Fujisawa, S. (2005). *Dictionary of basic tesuji: Tesuji for defending* (S. Bretherick, Trans. Vol. 2). Richmond, VA: Slate & Shell.

Fujisawa, S. (2006). *Dictionary of basic tesuji: Tesuji for the opening, for capturing races, and for life and death problems, part 1* (S. Bretherick, Trans. Vol. 3). Richmond, VA: Slate & Shell.

Fujisawa, S. (2007). *Dictionary of basic tesuji: Tesuji for life and death part 2, and for the endgame* (S. Bretherick, Trans. Vol. 4). Richmond, VA: Slate & Shell.

Galbraith, J. R. (1977). *Organization design*. Reading, MA: Addison-Wesley.

GAPPS. (2007). *A Framework for Performance Based Competency Standards for Global Level 1 and 2 Project Managers* (1.7b ed.). Sydney, Australia: Global Alliance for Project Performance Standards.

Gardenfors, P. (2004). Conceptual spaces as a framework for knowledge representation. *Mind and Matter*, *2*(2), 9-27.

Gareis, R., & Huemann, M. (2000). Project management competences in the project-oriented organization. In J. R. Turner & S. J. Simister (Eds.), *Gower handbook of project management* (3rd ed., pp. 709-721). Aldershot, UK: Gower.

Garlock, C. (2008). E-journal interview: Takemiya Masaki 9P. *American Go E-Journal, 9*(28). Retrieved from http://www.usgo.org/EJournal/archive/20080602/20080602.htm

Garlock, C. (2010a). Michael Redmond on studying, improving your game and how the pros train. . *AGA E-Journal*. Retrieved from www.usgo.org website: http://www.usgo.org/news/2010/06/michael-redmond-on-studying-improving-your-game-and-how-the-pros-train/

Garlock, C. (2010b). Yasumasa Hane 9P on American go, studying and chasing the dream. *2010 American Go Yearbook,* 18.

Gavetti, G., Levinthal, D. A., & Rivkin, J. W. (2005). Strategy making in novel and complex worlds: The power of analogy. *Strategic Management Journal*, *26*, 691-712.

Gavetti, G., & Rivkin, J. W. (2005). How strategists really think: Tapping the power of analogy. *Harvard Business Review, 83*(4), 54-63.

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science*(7), 155-170.

Gentner, D. (1998). Analogy. In W. Bechtel & G. Graham (Eds.), *A companion to cognitive science* (pp. 107-113). Oxford: Blackwell.

Gentner, D., & Schumacher, R. M. (1986). *Use of structure mapping theory for complex systems*. Paper presented at the IEEE International Conference on Systems, Man and Cybernetics, Panel on Mental Models and Complex Systems.

Gido, J., & Clements, J. P. (2006). *Successful project management* (3rd ed.). Mason, OH: Thomson South-western.

Giguette, R. (2006). Building objects out of Plato: Applying philosophy, symbolism, and analogy to software design. *Communications of the ACM, 49*(10), 66-71.

Go. (1942, May 18). *Life*, 92-96.

Go Books. (2008) Retrieved March 12, 2011, from http://gobooks.nemir.org/browse.html

Go, S. (1997). *A way of play for the 21st century* (K. J. Elchert, Trans. English ed.). Los Altos, CA, USA: Whole Board Press.

Goleman, D. (1995). *Emotional intelligence: Why it can matter more than IQ*. New York: Bantam Books.

Gonzalez, C., Vanyukov, P., & Martin, M. K. (2005). The use of microworlds to study dynamic decision making. *Computers in Human Behavior, 21*, 273-286.

Goswami, U. (2001). Analogical reasoning in children. In D. Gentner, K. J. Holyoak & B. Kokinov (Eds.), *The analogical mind: Perspectives from cognitive science* (pp. 437-470). Cambridge, MA: MIT Press.

Guidice, R. M., Alder, G. S., & Phelan, S. E. (2009). Competitive bluffing: An examination of a common practice and its relationship with performance. *Journal of Business Ethics*, *87*, 535-553.

Guo, T., & Lu, W. (1983). *Strategic fundamentals in go* (S. W. K. Yuan, Trans.). Santa Monica, CA, USA: Yutopian Enterprises.

Halford, G., Wilson, W., & Phillips, S. (1998). Processing capacity defined by relational complexity: Implications for comparative, developmental, and cognitive psychology. *Behavioral and Brain Sciences, 21*(6), 803-865.

Hamel, G., & Prahalad, C. K. (1994). *Competing for the future*. Boston, MA: Harvard Business School Press.

Hamlyn, D. W. (2005). Epistemology, history of. *The Oxford Companion to Philosophy* Retrieved November 12, 2011, from http://www.oxfordreference.com.libproxy.uregina.ca:2048/views/ENTRY.html?subview=Main&entry=t116.e762

Hammond, J. S., Keeney, R. L., & Raiffa, H. (1999). *Smart choices: a practical guide to making better life decisions*. New York, NY: Broadway Books.

Hanisch, B., & Wald, A. (2011). A project management research framework integrating multiple theoretical perspectives and influencing factors. *Project Management Journal, 42*(3), 4-22.

Haruyama, I., & Nagahara, Y. (1969). *Basic techniques of go* (Vol. 1). Tokyo: Ishi Press.

Hawkins, D. E., & Rajagopal, S. (2005). *Sun Tzu and the project battleground: Creating project strategy from "The Art of War"*. Basingstoke, UK: Palgrave Macmillan.

Hernes, T., & Bakken, T. (2003). Implications of self-reference: Niklas Luhmann's autopoiesis and organization theory. *Organization Studies*, *24*(9), 1511-1535.

Hesse, M. (1966). *Models and analogies in science*. Notre Dame, Indiana: University of Notre Dame Press.

Hesse, M. (1988). Theories, family resemblances and analogy. In D. H. Helman (Ed.), *Analogical reasoning: Perspectives of artificial intelligence, cognitive science, and philosophy* (pp. 317-340). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Hessler, P. (2001, October). Rising to life; Treasures of ancient China. *National Geographic, 200,* 59.

Hiatt, J. M. (2006). *ADKAR: A model for change in business, government and our community*. Loveland, CO: Prosci Research.

Hiatt, J. M., & Creasey, T. (2003). *Change management: The people side of change* (First ed.). Loveland, CO: Prosci Research.

Highsmith, J. (2004). *Agile project management: Creating innovative products*. Boston: Addison-Wesley.

Hillson, D. (2009). *Managing risk in projects*. Farnham, UK: Gower

Hofstadter, D. R. (1979). *Godel, Escher, Bach: An eternal braid* (20th Anniversary ed.). New York: Basic Books.

Hofstadter, D. R. (2001). Epilogue: Analogy as the core of cognition. In D. Gentner, K. J. Holyoak & B. Kokinov (Eds.), *The analogical mind: Perspectives from cognitive science* (pp. 499-538). Cambridge, MA: Bradford Books.

Holyoak, K. J., Gentner, D., & Kokinov, B. (2001). The place of analogy in cognition. In D. Gentner, K. J. Holyoak & B. Kokinov (Eds.), *The analogical mind: perspectives from cognitive science* (pp. 1-20). Cambridge, MA: MIT.

Holyoak, K. J., & Thagard, P. (1995). *Mental leaps: Analogy in creative thought* (MIT Press paperback ed.). Cambridge, MA: MIT Press.

Holyoak, K. J., & Thagard, P. (1997). The analogical mind. *American Psychologist, 52*(1), 35-44.

Howard, N. (1986). Usefulness of metagame analysis. *Journal of the Operational Research Society, 37*(4), 430-432.

Hunter, D. (2004). Teaching and using analogy in law. *Journal of the Association of Legal Writing Directors, 2*(Fall2004), 151-168.

Inoue, N. (2001, August 26, 2001). Go census Retrieved February 17, 2011, from http://www.fin.ne.jp/~igo/census.htm

Ireland, L. R. (2009). Project lessons through chess Retrieved November 15, 2010, from www.asapm.org/asapmag/articles/PrezSez06-09.pdf

Ishida, A., & Davies, J. (1980). *Attack and defense*. Tokyo: Ishi Press.

Ishida, Y. (1977a). *Dictionary of basic joseki* (J. Power, Trans. Vol. 2). Tokyo: Kiseido.

Ishida, Y. (1977b). *Dictionary of basic joseki* (J. Power, Trans. Vol. 1). Tokyo: Kiseido.

Ishida, Y. (1977c). *Dictionary of basic soseki* (Vol. 3). Tokyo: Kiseido.

Ishigure, I. (1973). *In the beginning: The opening in the game of go*. Tokyo: Ishi Press.

Itkonen, E. (2005). *Analogy as structure and process: Approaches in linguistics, cognitive psychology and philosophy of science*. Amsterdam, The Netherlands: John Benjamins B.V.

Jaafari, A. (2003). Project management in the age of complexity and change. *Project Management Journal, 34*(4), 47-57.

Jasiek, R. (2011). Go (Weiqi, Baduk) ISBN rating list Retrieved March 12, 2011, from http://home.snafu.de/jasiek/isbn.html

Jeong, S.-h. (2007). *Baduk and management*. Paper presented at the Baduk Tournament for Business People, Seoul, South Korea.

Jiang, M., & Miller, A. (2003). *Punishing and correcting joseki mistakes*. Richmond, VA: Slate & Shell.

Jugdev, K. (2004). Through the looking glass: Examining theory development in project management with the resource-based view lens. *Project Management Journal, 35*(3), 15-26.

Juthe, A. (2005). Argument by analogy. *Argumentation, 19*(1), 1-27. doi: 10.1007/s10503-005-2314-9

Kageyama, T. (1978). *Lessons in the fundamentals of go*. Tokyo: Ishi Press.

Kajiwara, T. (1979). *The direction of play* (J. Fairbairn, Trans.). Tokyo: Ishi Press.

Kajiware, T. (1979). *The Direction of Play* (J. Fairbairn, Trans.). Tokyo: Ishi Press.

Kalogerakis, K., Luthje, C., & Herstatt, C. (2010). Developing innovations based on analogies: Experience from design and engineering consultants. *Journal of Product Innovation Management, 27*, 418-436.

Kato, M., Rin, K., Ishida, A., & Kobayashi, R. (1986, Winter 1986-7). The secret of Kobayashi Koichi's strength. *Go World, 46,* 38-47.

Kawakuma, H. (2005, Autumn). The 9th LG Cup, game four: Cho's first world title. *Go World,* 21-26.

Keeley, D. (2007). *The mark of a leader: Inspiring stories of ordinary people who have done extraordinary things*. Toronto, ON: The Mark of a Leader.

Kendall, G. I., & Rollins, S. C. (2003). *Advanced project portfolio management and the PMO: Multiplying ROI at warp speed*. Boca Raton, FL: J. Ross Publishing.

Kensaku, S. (1960). *Go proverbs illustrated*. Tokyo: Nihon Kiin.

Kerzner, H. (2009a). *Project management case studies* (3rd ed.). Hoboken, NJ: Wiley & Sons.

Kerzner, H. (2009b). *Project management: A systems approach to planning, scheduling, and controlling* (10th ed.). Hoboken, NJ: John Wiley & Sons.

Keynes, J. M. (1921). *Treatise on probability*. London: Macmillan & Co.

Kilgour, D. M., & Hipel, K. W. (2005). Graph model for conflict resolution. *Group Decision and Negotiation, 14*(6), 441-460.

Kim, J., & Jeong, S.-h. (1997). *Learn to play go: Battle strategies* (Vol. 4). Denver, CO: Good Move Press.

Kim, J., & Jeong, S.-h. (1998). *Learn to play go: The dragon style* (2nd ed. Vol. 3). Sheboygan, WI: Good Move Press.

Kim, J., & Jeong, S.-h. (2003). *Learn to play go: The palace of memory* (Vol. 5). Denver, CO: Good Move Press.

Kim, S.-R. (2005a). *Train like a pro* (L. Waller, Trans. Vol. 1). Seoul: Oromedia.

Kim, S.-R. (2005b). *Train like a pro* (L. Waller, Trans. Vol. 2). Seoul: Oromedia.

Kim, S.-R. (2009). *This is haengma* (D. Koszegi, Trans.). Seoul, KR: Global Baduk.

Kissinger, H. A. (2004, November 8). America's assignment. *Newsweek, 144,* 30-35.

Koestler, A. (1964). *The act of creation*. London: Hitchinson & Co.

Kokinov, B. (1996). Analogy-making: Psychological data and computational models. In B. Kokinov (Ed.), *Perspectives on cognitive science* (Vol. 2, pp. 7). Sofia, Bulgaria: NBU Press.

Koskela, L. (2000). *An exploration towards a production theory and its application to construction.* Doctoral Dissertation, Technical Research Centre of Finland (VTT), Espoo, Finland. Available from Proquest Dissertations and Theses (304680100)

Koskela, L., & Ballard, G. (2006). Should project management be based on theories of economics or production? *Building Research & Information, 34*(2), 154-163.

Koskela, L., & Howell, G. (2002a, August 6-8). *The theory of project management: Explanation to novel methods.* Paper presented at the International Group for Lean Construction, Porto Alegre.

Koskela, L., & Howell, G. (2002b, July 14-17). *The underlying theory of project management is obsolete.* Paper presented at the PMI Research Conference, Seattle.

Kosugi, K., & Davies, J. (1973). *38 basic joseki*. Tokyo: Ishi Press.

Kozak-Holland, M. (2005). *Titanic lessons for IT projects*. Oshawa, ON: Multi-Media Publications.

Kozak-Holland, M. (2007). *Project lessons from the great escape (Stalag Luft III)*. Oshawa, ON: Multi-Media Publications.

Kozak-Holland, M. (2009). *Agile leadership and the management of change: Project lessons from Winston Churchill and the battle of Britain*. Oshawa, ON: Multi-Media Publications.

Kozak-Holland, M. (2010). *The History of Project Management: Project Management across 4,500 Years*. Oshawa, CA: Multi-Media Publications.

Kozak-Holland, M. (2011). *The history of project management*. Oshawa, CA: Multi-Media Publications.

KPMG. (2005). Global IT project management survey: How commited are you? Sydney, Australia: KPMG.

Kuhn, T. S. (1996). *The structure of scientific revolutions* (Third ed.). Chicago, IL: University of Chicago Press.

Kyle, M. (1998). *Making it happen: A non-technical guide to project management*. Toronto: John Wiley & Sons Canada.

Lamond, G. (2006). Precedent and analogy in legal reasoning. *Stanford Encyclopedia of Philosophy*. Retrieved from http://plato.stanford.edu/archives/sum2006/entries/legal-reas-prec/

Lang, K. R., & Zhang, J. L. (1999). *A Taoist foundation of system modeling and thinking*. Paper presented at the 17th International Conference of The System Dynamics Society and the 5th Australian & New Zealand Systems Conference, Wellington, NZ.

Laufer, A. (2003). Letting go of "Once and for all". *ASK Magazine,* (19). Retrieved from http://askmagazine.nasa.gov/issues/13/overview/ask13_resources_letterfromtheeditor.html

Laufer, A. (2009). *Breaking the code of project management*. Basingstoke, UK: Palgrave Macmillan.

Laufer, A., & Hoffman, E. J. (2000). *Project management success stories: Lessons of project leaders*. New York: John Wiley & Sons.

Le Roy, F. (2001). Le transfert de concepts en sciences de gestion : métaphores, analogies et modélisations analytiques. *Revue Sciences de Gestion*(29), 153-174.

Levine, H. A. (2005). *Project portfolio management: A practical guide to selecting projects, managing portfolios, and maximizing benefits*. San Francisco, CA: Jossey-Bass.

Lewicki, R. J., & Hiam, A. (2006). Mastering business negotiation - a working guide to making deals and resolving conflict Retrieved from http://common.books24x7.com.libproxy.uregina.ca:2048/toc.aspx?bookid=16697

Leybourne, S. A. (2007). The changing bias of project management research: A onsideration of the literatures and an application of extant theory. *Project Management Journal, 38*(1), 61-73.

Leybourne, S. A. (2009). Improvisation and agile project management: a comparative consideration *International Journal of Managing Projects in Business, 4*(2), 519-535.

Loch, C., De Meyer, A., & Pich, M. T. (2006). *Managing the unknown: A new approach to managing high uncertainty and risk in projects*. Hoboken, NJ: John Wiley & Sons.

Low, S. P. (1995). Lao Tzu's Tao Te Ching and its relevance to project leadership in construction. *International Journal of Project Management, 13*(5), 295-302. doi: 10.1016/0263-7863(95)00021-h

Lowe, E. J. (2005). Ontology*The Oxford Companion to Philosophy*. Oxford Reference Online: Oxford University Press. Retrieved from http://www.oxfordreference.com.libproxy.uregina.ca:2048/views/ENTRY.html?subview=Main&entry=t116.e1806.

Ma, X. (2000). *The thirty-six strategems applied to go*. San Francisco, CA: Yutopian.

Macheridis, N., & Nilsson, C.-H. (2004). Managing project complexity - a managerial view *Working Paper Series*. Lund, Sweden: Lund Institute of Economic Research, Department of Business Administration, Lund University.

Magenau, J. M., & Pinto, J. K. (2004). Power, influence, and negotiation in project management. In P. W. G. Morris & J. K. Pinto (Eds.), *The Wiley guide to managing projects* (pp. 1033-1060). Hoboken, NJ: Wiley.

Manas, J. (2009). *Project Lessons from the Roman Empire: An Ancient Guide to Modern Project Management*. Oshawa, ON: Multi-Media Publications.

Mayer, B. (2009). *Staying with conflict : A strategic approach to ongoing disputes*. Hoboken, NJ: Jossey-Bass.

McConnell, S. (2010). The cone of uncertainty Retrieved December 29, 2010, from http://www.construx.com/Page.aspx?hid=1648

Meredith, J. R., & Mantel, S. J. (2006). *Project Management: A Managerial Approach* (6th ed.). Hoboken, NJ: John Wiley & Sons.

Meredith, J. R., & Mantel, S. J. (2009). *Project management: A managerial approach* (7th ed.). Hoboken, NJ: John Wiley & Sons.

Mitchell, D. (2001). *Go proverbs*. Richmond, VA: Slate & Shell.

Miura, Y. (1995). *Go: An Asian paradigm for business strategy*. Tokyo: Kiseido.

Morçöl, G. (2001). What is complexity science? Postmodernist or postpositivist? *Emergence, 3*(1), 104-119.

Morris, P. W. G. (2000). *Researching the unanswered questions of project management*. Paper presented at the PMI Research Conference, Paris. http://www.indeco.co.uk/index.php?id=library

Morris, P. W. G. (2002). Science, objective knowledge and the theory of project management. *Proceedings of ICE*(150), 82-90.

Morris, P. W. G., & Hough, G. H. (1987). *The anatomy of major projects: A study of the reality of project management*. Chichester: John Wiley & Sons.

Morris, P. W. G., & Jamieson, A. (2005). Moving from corporate strategy to project strategy. *Project Management Journal, 36*(4), 5-18.

Morris, P. W. G., & Pinto, J. K. (2007). *The Wiley guide to project, program & portfolio management*. Hoboken, NJ: John Wiley & Sons.

Morrison, C. T., & Dietrich, E. (1995). *Structure-mapping vs. high-level perception: The mistaken fight over the explanation of analogy.* Paper presented at the Seventeenth Annual Conference of the Cognitive Science Society, Pittsburgh, PA.

Mulcahy, R. (2005). *PMP exam prep* (5th ed.). Minnetonka, MN: RMC Publications.

Muller, R. (2009). *Project governance*. Farnham, England: Gower.

Müller, R., Geraldi, J., & Turner, J. R. (2007). *Linking complexity and leadership competences of project managers*. Paper presented at the IRNOP VIII, Brighton, UK.

Nagahara, Y. (1972). *Strategic concepts of go*. Tokyo: Ishi Press.

Nakayama, N. (1984). *The treasure chest enigma: A go miscellany* (J. Power & R. Dolen, Trans.). Tokyo: Ishi Press.

Nam, C. (2004). *Contemporary go terms* (1st ed.). Seoul, Korea: Oromedia

NASA. (2007). *NASA systems engineering handbook*. (NASA/SP-2007-6105). Washington, DC: NASA Retrieved from http://ntrs.nasa.gov.

Nihon Ki-in. (1998). *Proverbs: Traditional wisdom for the game of go* (M. Golem, Trans.). Santa Monica, CA, USA: Yutopian Enterprises.

Novick, L. R. (1988). Analogical transfer: Processes and individual differences. In D. H. Helman (Ed.), *Analogical reasoning: Perspectives of artificial intelligence, cognitive* *science, and philosophy* (pp. 125-145). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Ogden, D. L., Thompson, R. K. R., & Premack, D. (2001). Can an ape reason analogically? Comprehension and production of analogical problems by Sarah, a chimpanzee (*Pan troglodytes*). In D. Gentner, K. J. Holyoak & B. Kokinov (Eds.), *The analogical mind: Perspectives from cognitive science* (pp. 471-497). Cambridge, MA: MIT Press.

Otake, H. (1992). *Opening theory made Eeasy*. Tokyo: Ishi Press.

Otake, H. (2007). *Otake's secrets of strategy*. Libertyville, IL: Hinoki Press.

Papineau, E. (2001). The game of go: A Chinese way of seeing the world. *China Perspectives,* (33), 43-55. Retrieved from http://www.scribd.com/doc/49693650/Go-Igo-Baduk-Weiqi-A-Chinese-Way-to-See-the-world

Park, C.-m. (2009, March 4). Korea draws aspiring baduk masters, *JoongAng Daily*. Retrieved from http://joongangdaily.joins.com/article/view.asp?aid=2901755

Paton, S., Hodgson, D., & Cicmil, S. (2010). Who am I and what am I doing here? Becoming and being a project manager. *Journal of Management Development, 29*(2), 157-166. doi: 10.1108/02621711011019297

Pich, M. T., Loch, C. H., & De Meyer, A. (2002). On uncertainty, ambiguity, and complexity in project management. *Management Science, 48*(8), 1008-1023.

Pinckard, W. (2001a). The game. In R. Bozulich (Ed.), *The go player's almanac 2001*. Tokyo: Kiseido.

Pinckard, W. (2001b). Go and the three games. In R. Bozulich (Ed.), *The go player's almanac 2001*. Tokyo: Kiseido.

Pinckard, W. (2001c). The history and philosophy of go. In R. Bozulich (Ed.), *The go player's almanac 2001*. Tokyo: Kiseido.

Pinckard, W. (2001d). Some senryu about go. In R. Bozulich (Ed.), *The go player's almanac 2001*. Tokyo: Kiseido.

Pinto, J. K. (1996). *Power & politics in project management*. Newtown Square, PA: Project Management Institute.

Pinto, J. K., & Kharbanda, O. P. (1996). How to fail in project management (without really trying). *Business Horizons, 37*(4), 45-53.

Pinto, J. K., & Mantel, S. J. (1990). The causes of project failure. *IEEE Transactions on Engineering Management*, *37*(4), 269-276.

Pinto, J. K., & Slevin, D. P. (1988a). Critical success factors across the project life cycle. *Project Management Journal*, *19*(3), 67-75.

Pinto, J. K., & Slevin, D. P. (1988b). Project success: Definitions and measurement techniques. *Project Management Journal, 19*(1), 67-72.

Plato. (1992). *The republic* (T. M. A. Grube & C. D. C. Reeve, Trans. 2nd ed.). Indianapolis, IN: Haskett Publishing Co.

Pollack, J. (2007). The changing paradigms of project management. *International Journal of Project Management*, *25*, 266-274.

Pólya, G. (1957). *How to solve it: A new aspect of mathematic method*. Garden City, NY: Doubleday.

Portny, S. E., Mantel, S. J., Meredith, J. R., Shafer, S. M., Sutton, M. M., & Kramer, B. E. (2008). *Project management: Planning, scheduling, and controlling projects*. Hoboken, NJ: John Wiley & Sons.

Potter, D. (2001). The three virtues of go. In R. Bozulich (Ed.), *The go player's almanac 2001*. Tokyo: Kiseido.

Power, J. (1982). *Invincible: The games of Shusaku* (J. Power, Trans.). Tokyo: Kiseido.

Power, J. (2009, Spring). Japanese prizes and statistics for 2008. *Go World, 118,* 11.

Power, J. (2011). Go world news. *Go World, 124,* 5-6.

Prescott, J. E., & Smith, D. C. (1987). A project-based approach to competitive analysis. *Strategic Management Journal*, *8*(5), 411-423.

Project Management Institute. (2006). *Practice standard for work breakdown structures* (Second ed.). Newtown Square, PA: Author.

Project Management Institute. (2007). *Project manager competency development (PMCD) framework* (Second ed.). Newtown Square, PA: Author.

Project Management Institute. (2008a). *A guide to the project management body of knowledge (PMBoK Guide)* (Fourth ed.). Newtown Square, PA: Author.

Project Management Institute. (2008b). *The standard for portfolio management* (Second ed.). Newtown Square, PA: Author.

Quesada, J., Kintsch, W., & Gomez, E. (2005). Complex problem-solving: a field in search of a definition? *Theoretical Issues in Ergonomics Science, 6*(1), 5-33.

Richardson, B. (2009). *Thinking on purpose for project managers: Outsmarting evolution*. Oshawa, ON: Multi-Media Publications.

Richardson, K. A. (2000). *Project management is complex! So what? [Powerpoint presentation]*. Paper presented at the IRNOP IV, Sydney, Australia.

Richardson, K. A., Lissack, M. R., Tait, A., & Roos, J. (2001). The coherent management of complex projects and the potential role of group decision support systems. *SysteMexico, 2*(1), 4-30.

Rin, K. (2001). *Come up to shodan* (J. Langdon, Trans.). Richmond, VA, USA: Slate & Shell.

Rosch, E. (1999). Reclaiming concepts. *Journal of Consciousness Studies, 6*(11-12).

Rost, J. C. (1991). *Leadership for the twenty-first century*. New York, NY: Praeger Publishers.

Rowe, W. D. (1994). Understanding uncertainty. *Risk Analysis, 14*(5), 743-750.

Saynisch, M. (2010a). Beyond frontiers of traditional project management: An approach to evolutionary, self-organizational principles and the complexity theory-results of the research program. *Project Management Journal, 41*(2), 21-37.

Saynisch, M. (2010b). Mastering complexity and changes in projects, economy, and society via project management second order (PM-2). *Project Management Journal, 41*(5), 4-20.

Schelle, H., Ottmann, R. E., & Pfeiffer, A. (2006). *Project manager*. Nuremberg, Germany: German Association for Project Management.

Schwaber, K. (2004). *Agile project management with scrum*. Redmond, WA: Microsoft Press.

Schwaber, K., & Beedle, M. (2002). *Agile software development with scrum*. Upper Saddle River, NJ: Prentice Hall.

Senge, P. (1990). *The fifth discipline: The art and practice of the learning organization*. New York: Currency Doubleday.

Sensei's Library. (2011). Go Books. *Sensei's Library* Retrieved March 12, 2011, from http://senseis.xmp.net/?GoBooks

Shelley, C. (2003). *Multiple analogies in science and philosophy*. Amsterdam, The Netherlands: John Benjamins.

Shen, G. (1996). *Beauty and the beast: Exquisite play and go theory* (R. C. Schmidt, Trans.). Santa Monica, CA: Yutopian.

Shenhar, A. J. (2004). Strategic project leadership: Toward a strategic approach to project management. *R&D Management, 34*(5), 569-578.

Shenhar, A. J. (2008). Unleashing the power of project management. *Industrial Management, 50*(1), 14-18.

Shenhar, A. J., & Dvir, D. (2007). *Reinventing project management: The diamond approach to successful growth and innovation*. Boston, MA: Harvard Business School Press.

Shenhar, A. J., & Wideman, M. (2000). Optimizing project success by matching PM style with project type. *Max's Project Managment Wisdom*. Retrieved from http://www.maxwideman.com/papers/success/success.pdf

Shirakawa, M. (1999). *A journey in search of the origins of go* (A. Kitagawa, Trans.). Santa Monica, CA: Yutopian Enterprises.

Shotwell, P. (2001). Speculations on the origins of go. In R. Bozulich (Ed.), *The go player's almanac 2001*. Tokyo: Kiseido. (Reprinted from: http://www.usgo.org/bobhighlibrary/ Updated 2010).

Shotwell, P. (2003). *Go! More than a game*. Tokyo: Tuttle.

Shotwell, P. (2006). *Go basics: Concepts and strategies for new players*. Tokyo: Tuttle.

Shotwell, P. (2008). The game of go: Speculations on its origins and symbolism in ancient China Retrieved from http://www.usgo.org/bobhighlibrary/

Shtub, A., Bard, J. F., & Globerson, S. (2005). *Project management: Processes, methodologies, and economics* (2nd ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Simon, H. A. (1946). The proverbs of administration. *Public Administration Review, 6*(1), 53-67.

Simon, H. A. (1992). *Models of my Life*: HarperCollins Canada.

Simon, H. A., Dantzig, G. B., Hogarth, R., Plott, C. R., Raiffa, H., Schelling, T. C. et al. (1987). Decision making and problem solving. *Interfaces, 17*(5), 11-31.

Slevin, D. P., & Pinto, J. K. (2004). An overview of behavioral issues in project management. In P. W. G. Morris & J. K. Pinto (Eds.), *The Wiley guide to managing projects* (pp. 67-85). Hoboken, NJ: Wiley.

Smith, R. (1989). Project implementation: The new baby. *International Journal of Project Management, 7*(1), 43-45. doi: 10.1016/0263-7863(89)90053-7

Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard Business Review, 85*(11), 69-76.

Sobek, D., Ward, A., & Liker, J. (1999). Toyota's principles of set-based concurrent engineering *Sloan Management Review* (Vol. 40, pp. 67-83).

Sommer, S., & Loch, C. (2004). Selectionism and learning in projects with complexity and unforeseeable uncertainty. *Management Science, 50*(10), 1334-1347.

Stacey, R. D. (2001). *Complex responsive processes in organizations: Learning and knowledge creation*. London: Routledge.

Stacey, R. D., Griffin, D., & Shaw, P. (2000). *Complexity and management: Fad or radical challenge to systems thinking?* New York: Routledge.

Standish Group. (1995). The Standish Group report - chaos: The Standish Group.

Suen, H., Cheung, S.-O., & Mondejar, R. (2007). Managing ethical behaviour in construction organizations in Asia: How do the teachings of Confucianism, Taoism and Buddhism and globalization influence ethics management? *International Journal of Project Management, 25*, 257-265.

Sutherland, J., & Schwaber, K. (2010). The scrum papers: Nuts, bolts, and origins of an agile framework   Retrieved from http://jeffsutherland.com/scrumpapers.pdf

Tannert, C., Elvers, H.-D., & Jandrig, B. (2007). The ethics of uncertainty. *EMBO Reports, 8*(10), 892-896. doi: doi:10.1038/sj.embor.7401072

Terry, B. (1987, Winter). The magnificent obsession: Sakata Eio and go. *Go World, 50*, 54-77.

Thagard, P. (2001). How to make decisions: Coherence, emotion, and practical inference. In E. Millgram (Ed.), *Varieties of practical inference* (pp. 355-371). Cambridge, MA:

MIT Press. Retrieved from http://cogsci.uwaterloo.ca/Articles/Pages/how-to-decide.html.

Tromp, J. (2010). Number of chess diagrams and positions Retrieved October 6, 2010, from http://homepages.cwi.nl/~tromp/chess/chess.html

Tromp, J., & Farnebäck, G. (2009). Combinatorics of go. Retrieved from http://homepages.cwi.nl/~tromp/go/gostate.ps

Turner, J. R. (2006a). Towards a theory of project management: The functions of project management. *International Journal of Project Management*, *24*(3), 3.

Turner, J. R. (2006b). Towards a theory of project management: The nature of the functions of project management. *International Journal of Project Management, 24*(4), 3.

Turner, J. R. (2006c). Towards a theory of project management: The nature of the project. *International Journal of Project Management*, *24*(1), 1-2.

Turner, J. R. (2006d). Towards a theory of project management: The nature of the project governance and project management. *International Journal of Project Management*, *24*(2), 3.

Turner, J. R. (2007a). Projects and their management. In J. R. Turner (Ed.), *Gower handbook of project management* (4th ed., pp. 95-110). Aldershot, UK: Gower.

Turner, J. R. (Ed.). (2007b). *Gower handbook of project management* (4th ed.). Aldershot, UK: Gower.

Turner, J. R., & Cochrane, R. A. (1993). Goals-and-methods matrix: Coping with projects with ill defined goals and/or methods of achieving them. *International Journal of Project Management, 11*(2), 93-102.

Turner, J. R., Keegan, A., & Crawford, L. (2000). Learning by experience in the project-based organization *ERIM Report Series Research in Management*. Rotterdam: Erasmus University, Rotterdam School of Management.

Turner, J. R., & Müller, R. (2003). On the nature of the project as a temporary organization. *International Journal of Project Management, 21*(1), 1-8.

Turner, J. R., & Simister, S. J. (Eds.). (2000). *Gower handbook of project management* (3rd. ed.). Aldershot, Hampshire, UK: Gower.

Turner, M. (1988). Categories and analogies. In D. H. Helman (Ed.), *Analogical reasoning: Perspectives of artificial intelligence, cognitive science, and philosophy* (pp. 3-24). Dordrecht, the Netherlands: Kluwer Academic Publishers.

Van Cauwenberghe, P. (2004). An introduction to iterative and incremental delivery. In K. Aguanno (Ed.), *Managing agile projects* (pp. 75-86). Lakefield, ON: Multi-Media Publications.

VanLehn, K. (1991). Rule acquisition events in the discovery of problem-solving strategies. *Cognitive Science, 15*, 1-47.

Walker, W. E., Harremoes, P., Rotmans, J., Van Der Sluijs, J. P., Van Asselt, M. B. A., Janssen, P. et al. (2003). Defining uncertainty: A conceptual basis for uncertainty management in model-based decision support. *Integrated Assessment, 4*(1), 5-17.

Ward, S., & Chapman, C. (2003). Transforming project risk management into project uncertainty management. *International Journal of Project Management, 21*(2), 97-105.

Wedd, N. (2010). Human-computer go challenges Retrieved January 28, 2011, from http://www.computer-go.info/h-c/index.html

Whitty, S. J., & Maylor, H. (2007). *And then came complex project management*. Paper presented at the 21st IPMA World Congress on Project Management, Krakow, Poland.

Wideman, M. (2000). First principles of project management Retrieved 2004-10-12, 2004, from http://www.maxwideman.com/papers/principles/principles.pdf

Wildavsky, A. (1988). *Searching for safety*. New Brunswick, USA: Transaction Books.

Williams, T. M. (1999). The need for new paradigms for complex projects. *International Journal of Project Management, 17*(5), 269-273.

Williams, T. M. (2002). *Modelling complex projects*. Chichester, UK: John Wiley & Sons, Ltd.

Williams, T. M. (2004). *Assessing and building on the underlying theory of project management in the light of badly over-run projects*. Paper presented at the PMI Research Conference, London, UK.

Winch, G. (2004). *Rethinking project management: Project organizations as information processing systems?* Paper presented at the PMI Research Conference, London

Winston, P. (1980). Learning and reasoning by analogy. *Communications of the ACM, 23*(12), 689-703.

Winter, M., Smith, C., Morris, P. W. G., & Cicmil, S. (2006). Directions for future research in project management: The main findings of a UK government-funded research network. *International Journal of Project Management, 24*(8), 638-649.

Winter, M., & Szczepanek, T. (2009). *Images of projects*. Farnham, UK: Gower.

Woodward, C. V. (1988). Strange career critics: Long may they persevere. *The Journal of American History, 75*(3), 857-868.

Worsley, C., & Docker, T. (2000). *Matching projects to project managers*. Paper presented at the IPMA World Congress, London.

Wu, S. (2006). *WeiQi in culture* (D. Chan & H. H. Siu, Trans.). Santa Monica, CA: Yutopian.

Wysocki, R. K. (2007). *Effective project management: Traditional, adaptive, extreme* (4th ed.). Indianapolis, IN: Wiley Publishing.

Wysocki, R. K. (2009). *Effective project management: Traditional, agile, extreme* (5th ed.). Indianapolis, IN: Wiley Publishing.

Yang, Y.-C. (2002). *A scientific introduction to go* (S. W. K. Yuan, Trans.). Santa Monica, CA, USA: Yutopian Enterprises.

Yoon, Y. (2006). *Think like a pro: Haengma*. Seoul: Oromedia.

Zhou, Y. (2007). *Master play: The style of Lee Changho*. Richmond, VA: Slate & Shell.

Zhou, Y. (2008a). *Master play: The style of Go Seigen*. Richmond, VA: Slate & Shell.

Zhou, Y. (2008b). *Master play: The style of Takemiya*. Richmond, VA: Slate & Shell.

Zhou, Y. (2009a). *How not to play go*. Richmond, VA: Slate & Shell.

Zhou, Y. (2009b). *Master play: The fighting styles of Kato Masao & Seo Bong Soo* Richmond, VA: Slate & Shell.

Zhou, Y. (2009c). *Master play: The territorial styles of Kitani Minoru & Cho Chikun*. Richmond, VA: Slate & Shell.

Zhou, Y. (2010). *Understanding dan level play*. Richmond, VA: Slate & Shell.

Appendices

Appendix A. Go principles: Alternative sources

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G01	Align each move with the goal						8	44		
G02	Ensure each move benefits the goal						10			
G03	Do a SWOT analysis			60	247		9	40		
G04	Each move helps build the goal						8			
G05	Global perspective dominates local perspective						9, 24	44		
G06	Balance global and local perspectives							44		
G07	Weaknesses require unplanned effort to fix						25	53, 59		
G08	Gain competence with a variety of experiences									Wu (2006, p. 53)
G09	Ensure each move is consistent with both strategic and tactical				40		5	57		
G10	Consider the future implications of moves before making them			98	153		25	44		
G11	Play away from strength		31,35	63			5			

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G12	Don't help your opponent play perfectly						4			
G13	Make flexible plans when the context is changeable						31			
G14	Prepare for many possibilities by playing flexible moves		40	65,86		ix				
G15	Every game of Go is unique									Wu (2006, p. 81)
G16	Change plans when the context changes						31			
G17	Take advantage of opportunities		19				23	58		
G18	Use all available resources, including previous moves			58						Otake (2007, p. 26)
G19	Gather all relevant information to gain a clear understanding of a situation in order to make				89,137			48,58		
G20	Understand the opponent's intentions to better understand a situation									Bozulich (2007, p. 29)
G21	Weak positions become weaker					ix				
G22	Adjust risk according to the score	136					12	39		

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G23	Take risks to gain competence									Garlock (2010b)
G24	Opportunities are created by the opponent making mistakes									Ma (2000, p. 51)
G25	Fix weaknesses before starting something new					ix	34			
G26	Balance risk and safety									Ishida and Davies (1980, p. 6)
G27	Resign when there is no way to achieve the goal		136		84					
G28	Choose moves in order by reward-to-risk ratio			8,60	95		1	6,21		
G29	Balance speed of development with stability						21			
G30	If the opponent presses too hard, counterattack strongly						5			
G31	Press the opponent to prevent achieving the opponent's goal						8			
G32	Push the opponent to achieve the project goal				84		8,12			

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G33	Attack the opponent indirectly			71						
G34	Play close to the opponent when defending								279	
G35	Play moves that increase strength, flexibility and resilience				166		24			
G36	Time moves to align with current priority and goal							40		
G37	Each move is a lost opportunity to do something else						24			
G38	Split the opponent into weak groups				40	x				
G39	Produce value before considering the situation "done"						26			
G40	To gain a deeper understanding of a concept, unlearn what has already been learned						1			
G41	Practice reading to increase reading competence				14					
G42	Practice reading to increase playing competence						25			

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G43	Increase reading competence by increasing playing competence									Garlock (2010b)
G44	Take risks, fail, and learn from those failures									Garlock (2010b)
G45	Analyze different sequences of activities to find the best one				93					Davies (1975, pp. 6-13)
G46	Balance planning forward and planning in reverse									Davies (1975, pp. 6-13)
G47	Defend a weakness by attacking an opponent's weakness					xi	11			
G48	Produce profit when attacking the opponent						5			
G49	Always know the score	136			82		21			
G50	A player's mistakes can be a source of opportunities						5			
G51	Understand opponent's intentions to make better plans									Ma (2000)
G52	Build and have confidence in your own ability				39			58		

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G53	To advance in a field, first learn the basics, then confront your comfort zones, and then develop your unique approach						1			
G54	Keep balance between player and opponent						5			
G55	Your opponent's best move is your best move								278	
G56	Members of teams need to communicate and coordinate									Fairbairn and Hall (2009, p. 5)
G57	Play strong opponents to increase competence									Wu (2006, p. 53)
G58	Listen to your teacher to increase competence									Garlock (2010b)
G59	Sacrifice some stones for a better chance to win		46		84					
G60	Clarity of objective is essential for knowing what to sacrifice							50		
G61	Take the initiative				247			46		
G62	Follow the opponent when going your way									Zhou (2009a, p. 6)

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G63	A player has a 50% chance of winning									Bozulich (2001, p.
G64	Be objective							53,60		
G65	Analyze the situation and the trajectory									Kajiwara (1979, p. 2)
G66	A good move has a good follow-up						3			
G67	Use a probe to gather information to clarify a situation		48					39		
G68	If you lead be careful, if you follow be careful									Zhou (2010, p. 104)
G69	Balance leading and following							46		
G70	Control your emotions					ix	25	31		
G71	Focus on a single objective when the situation is clear									Davies (1975, p. 6)
G72	Take the other equal opportunity		3							
G73	Play moves with multiple meanings								287	

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G74	Use influence to help create value in the future		31-35	66	88-109	xi				
G75	Commit to completing each objective									Kosugi and Davies (1973); Jiang and Miller (2003)
G76	Maintain uncertainty as long as possible	141	3							
G77	Planning is more important than the plan									Davies (1975, p. 5)
G78	Balance expansion and focus									Kim and Jeong (2003, pp. 104-109)
G79	Plan how to exit a situation before entering									Kim and Jeong (1997, p. 120)
G80	Create uncertainty for the opponent		5							
G81	The player is responsible for all decisions									Otake (2007, p. 28)
G82	Always do your best				181					

ID	Principle	Nakayama (1984)	Nagahara (1972)	Ishigure (1973)	Kageyama (1978)	Bozulich (2002)	Rin (2001)	Shen (1996)	Yang (2002)	Other
G83	Know your goal									Kim and Jeong (1998, p. 18)

Note. This appendix lists other sources for the proverbs used in this research and where they can be found. The alternative sources were all written by professional Go players or by professional Go writers. The proverbs were often worded differently from that used in this research, and were sometimes implied. The identifier of the proverb is listed in the first column; the proverbs themselves are listed in the second column, followed by a column for each alternate source. The numbers in the cells refer to the page numbers within the source.

Appendix B. Principles of Standard Project Management Practise

If inferences from the low-level analogies of Chapter 4 could be found in the following sources (with similar wording or as a corollary of statements in the source), they were considered to be standard or common in project management practice:

- Standards:
  - *A guide to the project management body of knowledge (PMBOK® Guide)* (Project Management Institute, 2008a),
  - *Practice standard for work breakdown structures* (Project Management Institute, 2006),
  - *Standard for portfolio management* (Project Management Institute, 2008b),
  - *IPMA Competence Baseline* (Caupin et al., 2006), and
  - *A framework for performance based competency standards for global level 1 and 2 project managers* (GAPPS, 2007).
- Popular university texts:
  - *Project management: Strategic design and implementation* (Cleland & Ireland, 2007),
  - *Project manager's portable handbook* (Cleland & Ireland, 2010),
  - *Project management: A systems approach to planning, scheduling, and controlling* (Kerzner, 2009b), and
  - *Project management: A managerial approach* (Meredith & Mantel, 2009),

- Reference books:
    - *The Wiley guide to project, program & portfolio management* (Morris & Pinto, 2007),
    - *Gower handbook of project management* (J. R. Turner, 2007b),
- PMP examination preparation texts:
    - *PMP exam prep* (Mulcahy, 2005).

Appendix C. Other Project Management Knowledge Sources

If inferences from the low-level analogies of Chapter 4 could be found in the following sources (with similar wording or as a corollary of statements in the source), they were considered to be in the project management literature, but not necessarily part of standard or common project management practice:

- Journals:
  - *Project Management Journal*,
  - *International Journal of Project Management*

- Agile methods:
  - *Managing agile projects* (Aguanno, 2004),
  - *Agile project management: Creating innovative products* (Highsmith, 2004),
  - *Agile project management with scrum* (Schwaber, 2004),
  - *Xtreme project management: Using leadership, principles, and tools to deliver value in the face of volatility* (DeCarlo, 2004),
  - *The scrum papers: Nuts, bolts, and origins of an agile framework* (Sutherland & Schwaber, 2010)

- Uncertainty and Risk:
  - *Managing project risk and uncertainty: A constructively simple approach to decision making* (Chapman & Ward, 2002),
  - *Managing risk in projects* (Hillson, 2009),

- *Managing the unknown: A new approach to managing high uncertainty and risk in projects* (Loch et al., 2006)

- Theory:
  - *Toward a project management theory for renewal projects* (Andersen, 2006),
  - Numerous works by Bredillet (Bredillet, 2004b, 2007a, 2007b, 2007c, 2008a, 2008b, 2008c),
  - Several works by Koskela (Koskela, 2000; Koskela & Howell, 2002a, 2002b),
  - Several works by Turner (J. R. Turner, 2006a, 2006b, 2006c, 2006d; J. R. Turner & Cochrane, 1993),
- Practice:
  - *Managing high-technology programs and projects* (Archibald, 2003a),
  - *The right projects done right! From business strategy to successful project implementation* (Dinsmore & Cooke-Davies, 2006),
  - *Project portfolio management: A practical guide to selecting projects, managing portfolios, and maximizing benefits* (Levine, 2005),
  - Several work by Pinto (Pinto, 1996; Pinto & Kharbanda, 1996; Pinto & Mantel, 1990; Pinto & Slevin, 1988a, 1988b),
  - *Effective project management: Traditional, agile, extreme* (Wysocki, 2009),
  - *The new project management: Tools for an age of rapid change, complexity, and other business realities* (Frame, 2002),
  - *Breaking the code of project management* (Laufer, 2009),
  - *Reinventing project management: The diamond approach to successful growth and innovation* (Shenhar & Dvir, 2007),

- *Modelling complex projects* (Williams, 2002),
- *Project governance* (Muller, 2009),
- *Thinking on purpose for project managers: Outsmarting evolution* (B. Richardson, 2009),
- *Making it happen: A non-technical guide to project management* (Kyle, 1998)

- Other project management articles, papers and presentations:
  - *Plans are nothing, changing plans is everything: The impact of changes on project success* (Dvir & Lechler, 2004),
  - *Who am I and what am I doing here? Becoming and being a project manager* (Paton et al., 2010) ,
  - *Rethinking project management: Project organizations as information processing systems?* (Winch, 2004),
  - *Learning by experience in the project-based organization* (J. R. Turner et al., 2000),
  - *Dynamic systems management methodology* (Daniel, 2007)

Appendix D. Two Decision-Making Processes

A decision-making process using analogy

The following process for making decisions is helped by using analogies in steps one and two from Holyoak and Thagard (1995, p. 144).

1. Identify relevant actions and goals. Some goals must have intrinsic importance. Analogy can help identify what matters and what can be done. Multiple analogies can suggest many possibilities.
2. Identify facilitation and incompatibility relations among the actions and goals. Analogies can help identify relations among actions and goals, and identify potential consequences.
3. Choose a coherent plan involving actions and goals. The best plan will consist of the set of actions and goals that most strongly facilitate each other and inhibit their rivals

According to Holyoad and Thagard (1995, p. 146), "a single analogue can seldom provide a complete basis for a decision; but aspects of several analogues can often provide part of the basis for developing a coherent plan. Although analogy-based inferences never guarantee optimal decisions, they derive the strongest possible justification when multiple source analogues are mapped to the target at the system level, with the results of these mappings being used as part of an overall evaluation of decision coherence."

A decision-making process using intuition

A general decision-making method that uses intuition, described in Thagard (2001), follows.

1. Set up the decision problem carefully. This requires identifying the goals to be accomplished by your decision and specifying the broad range of possible actions that might accomplish those goals.

2. Reflect on the importance of the different goals. Such reflection will be more emotional and intuitive than just putting a numerical weight on them, but should help you to be more aware of what you care about in the current decision situation. Identify goals whose importance may be exaggerated because of jonesing or other emotional distortions.

3. Examine beliefs about the extent to which various actions would facilitate the different goals. Are these beliefs based on good evidence? If not, revise them.

4. Make your intuitive judgment about the best action to perform, monitoring your emotional reaction to different options. Run your decision past other people to see if it seems reasonable to them.

Appendix E. A Sample Game of Go

Figures E1-E8 are a record of the final game of the ninth LG Cup Tournament (one of the top international professional Go tournaments), played in April 2005 between Yu Bin of China (Black) and Cho U representing Japan (White). The figures were based on the game commentary and game record from Kawakuma (2005). White won by 2½ points including komi of 6½ points.

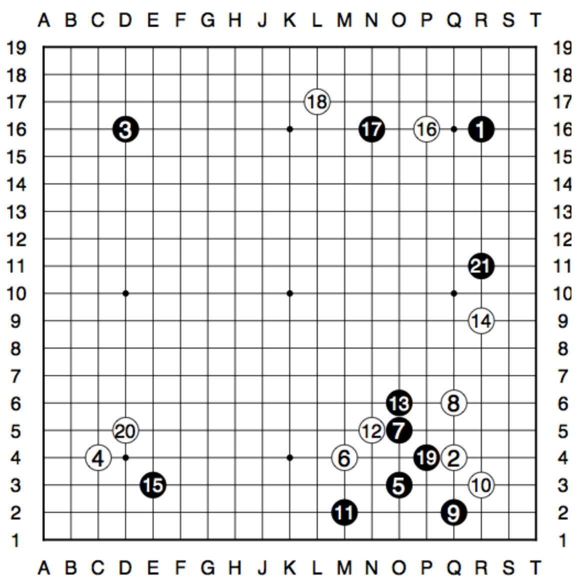

Figure E1. Moves 1-21.

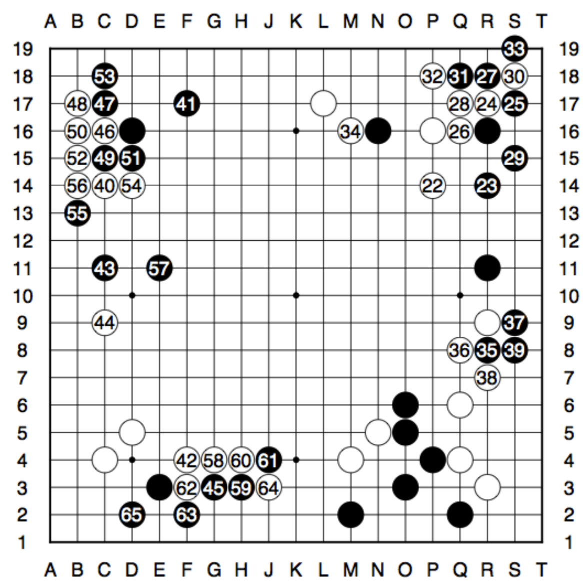

Figure E2. Moves 22-60.

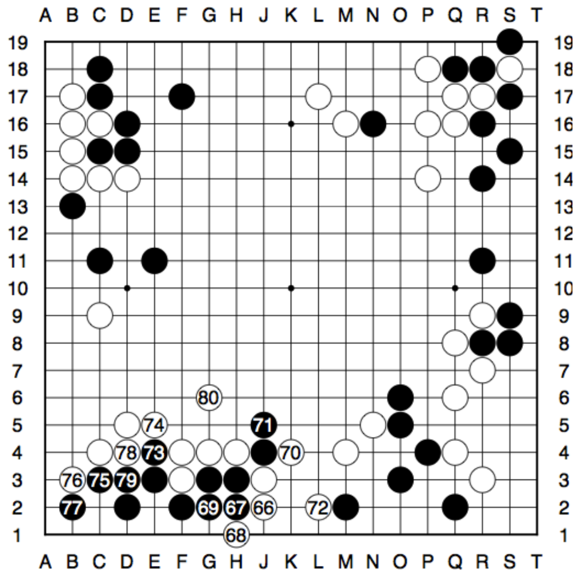

Figure E3. Moves 61-80.

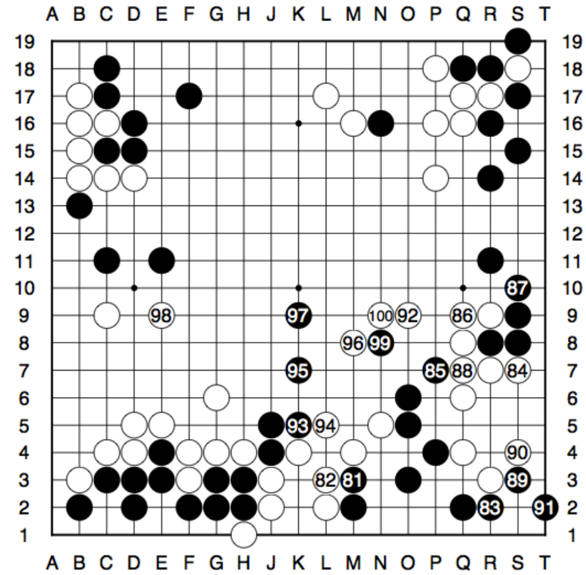

Figure E4. Moves 81-100.

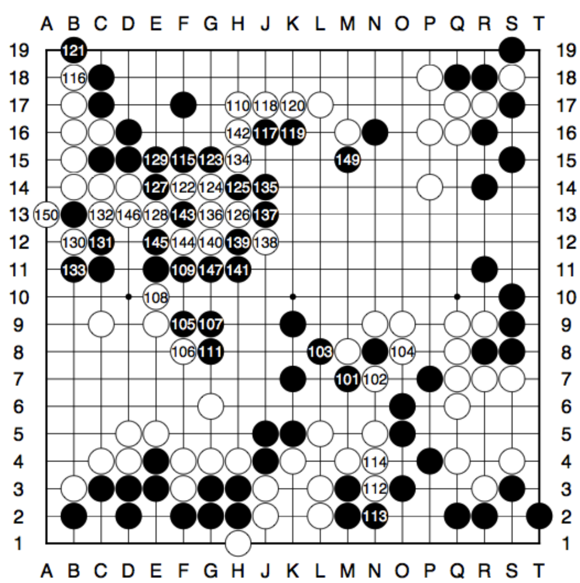

Figure E5. Moves 101-150; 148 at 143.

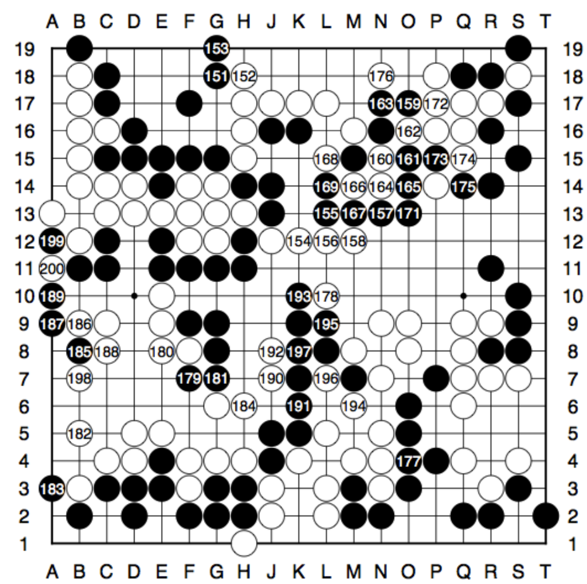

Figure E6. Moves 151-200; 170 at M15.

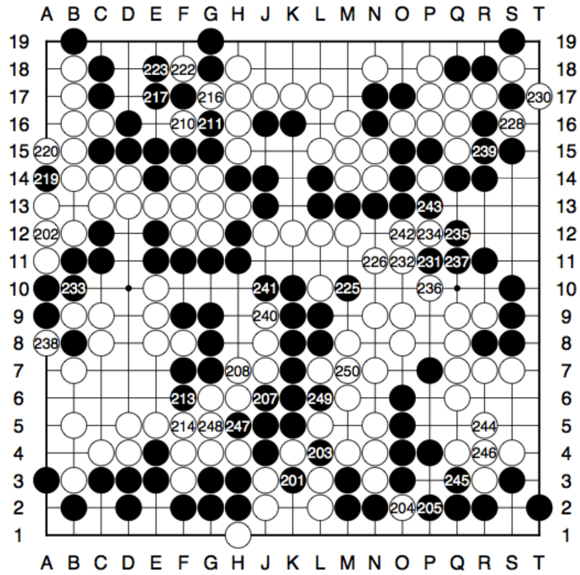

Figure E7. Moves 201-250; 206 at K4; 209 at 203; 212 at K4; 215 at 203; 218 at K4; 221 at 203, 224 at K4; 227 at 203; 229 at K4.

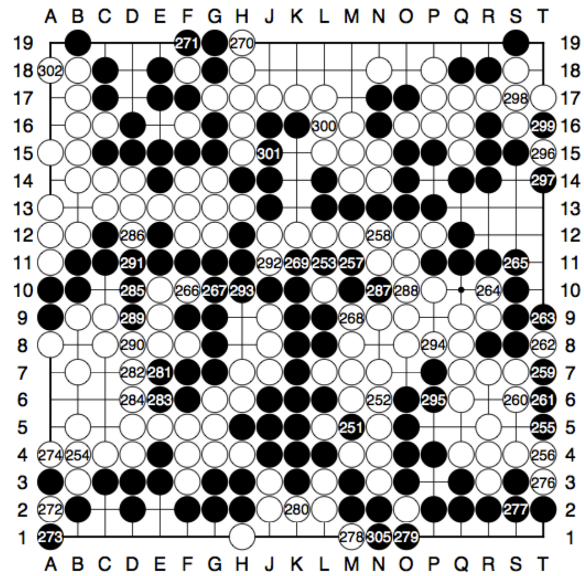

Figure E8. Moves 251-306; 275 at 272; 303 at 296; 304 at L5; 306 at 251.