Managing Murphy

essentials of project risk management

Applicable regardless of your preferred
methodology – PMBOK®, PRINCE2 or Agile.

by Dr Jim Young PMP FNZIM

Acknowledgements

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Jim Young
Author

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Foreword

Risk management is one of today's hottest topics. Most industries are now highly competitive and the project management mantra is faster, cheaper, better. With these pressures come risk.

Good risk management or poor risk management can mean the difference between project success and project failure. Good risk management allows us to respond proactively to risk and also allows us to react better to those risks that do occur.

Experience has shown that risk management must be of critical concern to all project managers, as unmanaged or unmitigated risks are a primary cause of project failure. Unfortunately, many managers and project managers believe risk management to be too difficult, too time consuming, or too complicated to perform. However, such concerns are unfounded and there is no doubt that successful risk management will greatly add to the probability of project success.

This book is a welcome and timely addition to the literature on risk management and will be of particular interest to those involved in project management. The author demystifies the topic and describes a standard framework for integrating risk management into the management of our projects.

Phillip Meyer FNZIM
Chairman
New Zealand Institute of Management

Preface

"Great deeds are usually wrought at great risk."
Herodotus

Herodotus, an ancient Greek historian, has been referred to as "The Father of Lies" due to his tendency to report fanciful information. However, the above quote, at least, is perfectly true – significant accomplishments are rarely possible without taking risks. The "no free lunches" mantra applies. Those who desire a reward need to be willing to expose themselves to risk. In fact, a no-risk project would not be worth pursuing, although of course there are no projects that are free of risk. It's said that there are only two certainties in life – death and taxes. However, there is a third – project risk. Projects are unavoidably risky and this book explains how we should manage that risk to improve the likelihood of project success.

Historically, New Zealanders haven't always given risk the respect it deserves, evidenced today for example by our road carnage. I understand that violence, car accidents and suicide are now the leading causes of adolescent deaths. Evidently death rates increase dramatically during the "risk-taking" years from 14 to 24, especially for males. One theory for Kiwi's relaxed attitude to risk is that many of our ancestors, Maori and Pakeha, must have been hopelessly optimistic to sail huge distances to carve out a life in a strange and hostile land. One wonders how many of those early explorers never found land and perished at sea. So perhaps it's part of our genetic heritage to focus on the upside and ignore the possibility that something could go wrong. The "she'll be right" attitude often prevails.

Nevertheless, in the last few years many New Zealanders and New Zealand organisations have become more risk-aware, and several more risk-averse, waiting for our economy to turn around. Although, rather than waiting, some organisations are taking this opportunity to further differentiate themselves by investing in new products and services, and by expanding their reach further into

existing markets and penetrating new markets, examples of which are Fulton Hogan's and Fletcher Building's recent forays into new business in Australia and United States. Yet many of our organisations have become more conservative. Management effort has been diverted to survival mode. This attitude has put project managers under the spot light. We are now expected to produce more efficiently and cost-effectively, while short-handed and with reduced budgets. If this situation seems familiar, then this book is definitely for you.

The devastation caused Christchurch and my experience with the practical application of project risk management prompted me to write this book. My 'action research' revealed that:

- Project risk management in New Zealand at least is poorly understood and even more poorly applied, although this is likely to be a more universal deficiency. The "she'll be right" attitude prevails.
- Projects worldwide are becoming more risky, largely as a consequence of exponential technological advances, an obsession with speed, worldwide credit woes and the global recession. Uncertainty is the new norm.
- Existing publications give insufficient attention to several important aspects of contemporary project risk management including its full integration with the project management process, treatment of assumptions and opportunities, transfer of risk, 'groupthink' and other stakeholder risks, understandable quantitative risk analysis, and risk management maturity.

This book aims to describe the practical application of the project management process, rectify the above mentioned factors, and provide persuasive arguments in favour of project risk management.

The book introduces a sound approach to risk management aimed at keeping us, our team and our organisation at the forefront of risk management, thus contributing to the success of all three. This approach to risk management is not

intended to promote uniformity across our organisations. Application needs to consider the varying needs of our specific organisations, including their goals, culture, values, context, structure, functions, products, services and so on.

Risk is ubiquitous. Our very lives are calculated risks, although the chances are we don't consciously perform risk management in a very deliberate way on a daily basis. When we drive to work, we assume a calculated risk that we will arrive safely. When we eat in a restaurant, we assume a risk that the food has been safely prepared. The key is that we control or could control these risks by driving defensively or choosing a clean restaurant.

You're also taking a risk reading this book. You're investing your time to find out more about project risk management – and I thank you for that – but it is time you can't regain once spent. Furthermore, in the meantime you may forego other opportunities. However, you will, I'm confident, reach the end of this book and realise that you've learnt more about managing risk than you knew before. You will have taken a risk and benefited from doing so, particularly if you then apply what you have learned. Of course, as the author, I would maintain that the greater risk for you is not to read this book at all.

While usually on a bigger scale than reading a book, projects are also investments with risk, which we undertake to reap some reward – perhaps profit or at least add value in some way. We need to be confident that the rewards justify the costs and the associated risks. Intelligent risk taking is a fundamental precept of enterprise, where no risk taking means no innovation, no competitive advantage and no shareholder value. And some failure is acceptable.

Risk is a four-letter word that can cause big problems. A risk is something in the future that may or may not occur and the future is inherently uncertain. Risks do not yet exist as problems, and they may never become problems. They are possible future problems. Projects are particularly susceptible to risk because each project is unique at least in some measure. Many projects are without precedence. The elements of project uniqueness can vary. A state-of-the-art research project will have more unique elements than a project to carry out the tenth installation of a heat pump. Uniqueness means that the past is an imperfect guide to the future. We can never be entirely sure what the future holds or whether previous lessons are entirely relevant to our current or next project. There is always a risk that

things will not go as planned – possibly better than we envisaged, or if we believe Murphy's Law, probably worse.

While uniqueness or novelty can introduce risk into a project, some other significant contributors to project risk include complexity, change, assumptions, constraints, and not least of all stakeholders – those individuals or groups whose interests may be affected by the project and/or who might influence project success. Nevertheless, with proper project risk management, organisations can defeat or at least subdue the Murphy factor to realise the following generic benefits:

- Projects will cost less and take less time to complete.
- More projects will be completed on time and within budget.
- Risks will be identified earlier and overly risky projects will be eliminated sooner, releasing resources for other pursuits.
- Better project selection decisions will be made, thus increasing the total value of our organisation's portfolio of projects.

The term risk management can mean many different things to different people. To some the phrase is exciting – it's all about taking and managing risks. To others the phrase is a turn-off. It reeks of control and bureaucracy. However we look at it, in a world of uncertainty, risk is inevitable and probably desirable. If we had no uncertainty and therefore no risk, then life would be entirely predictable, unrewarding and boring, although the truly risk averse may appreciate that.

While the future is uncertain, it is certain there is something that as project managers we will be asked, and asked often, about our every project, "How much will it cost and how long will it take?"

This question is posed in the future tense. We are being asked to predict. Because the future is uncertain, the fundamental answer to this question is that an estimate is more accurately expressed, not as a single number, but as a range. To determine a reasonably accurate range for cost and schedule, uncertainty must be considered. Risk exists as a consequence of uncertainty. Risk is always relative to something – a standard, reference point or estimate. There is no absolute risk. Of course the expression exact estimate is an oxymoron, and a precise estimate to the nearest hour or dollar only raises stakeholders' expectations about the degree of accuracy

possible, which leads to perceived failure when such unrealistic precision is not achieved. Estimates are expressed as ranges every day. For example, we might say that we'll arrive in 5 to 10 minutes. Ranges reflect our best knowledge of reality.

Estimates are typically comprised of two components – their base component and their risk component. Base estimates are the likely cost and time for the project if no significant risk occurs. Once the project base estimates are established, typically a list of risks is created of both opportunities and threats, and recorded in a risk register – sometimes called a risk log. Then effective risk assessment replaces vaguely defined contingency with explicitly defined risk events and assesses the probability or likelihood of their occurrence and the impact or consequences for the project should these risk events occur.

While risk management is required for every project, we should keep in mind that it is a scalable activity and our risk management efforts should be commensurate with the cost, size, novelty and complexity of our project if risk management is to add value. Simple and familiar projects may use only straightforward qualitative risk analysis. Larger more complex and novel projects usually justify and benefit from more robust quantitative risk analysis.

Despite best intentions, our organisations may suffer from "dead projects walking." These are unacceptably risky projects that should never have been commissioned or should have been terminated as soon as their unacceptable risk characteristics became evident. However, sometimes macho-style senior management and project sponsors can be complicit in keeping such disasters going. Instead of commending project managers whose conscientious risk assessments recommend early closure, at best they view such project managers as pitifully inadequate; at worst they are replaced. We can recognise those who doubt the value of project risk management from their comments, such as:

- *"The negative attitude that risk-finding encourages will undermine the project team's morale and motivation, and ultimately project success."*
- *"There is not enough time to indulge in mere possibilities. It's much more productive to get on with the real project work and react to actual problems if and when they arise."*
- *"Projects and the environments in which they are undertaken continuously change, which very quickly makes a nonsense of any risk management plan."*

- *"What do you mean you 'think' the project is low risk? That's defeatist talk. You'll need to be a whole lot more confident and convincing to ensure we get this project approved."*
- *"Risk management simply drives out innovation, which project management is all about."*

In fact, uncreative risk management is a contradiction. To be effective the risk management process must embody innovation and creative thinking in both risk identification and response.

Attitudes to project risk can vary widely from dangerously tolerant to dangerously intolerant. Part of the problem is that effective risk management is typically low profile and may therefore seem to be a thankless business since few issues then arise. Issues are actual problems. They are risks that have materialised. Arguably, the fewer issues that arise, the better our risk management has been – a key measure of risk management effectiveness. However, tackling an issue can be very high profile. Ask BP about oil spills and our New Zealand government about mining disasters and earthquakes.

A preliminary report tells us that BP and its partners made a series of cost-cutting decisions that ultimately contributed to the oil spill that ravaged the Gulf of Mexico. Hazardous and time-saving steps were without adequate consideration of the risks involved. Yet the oil spill already has a time-warp feel to it. The whole spill-cam experience, which lasted for 107 days, seems like ancient history partly because preliminary studies are showing far less environmental damage than first predicted. The joy of oil-gobbling bacteria has dulled our recollection of petroleum-drenched pelicans. Corporate obfuscation has also muddled the memory. But no doubt there will be gazillion-dollar settlements to come. To encourage an appropriate attitude to risk management, we need to more conscientiously recognise and reward the fire-preventers, rather than simply glorify the firefighters.

"Prevention is better than cure" is the most important risk management principle. This principle might be more meaningful if we relate it to our personal health. Most New Zealanders, men in particular, associate a medical health check with being ill. But for life-threatening illnesses, physical symptoms may only appear at an advanced stage. In fact, in a third of New Zealand cardiovascular disease cases, the first symptom is death. Given this sobering statistic, there are enormous

benefits in switching our focus from treatment to early detection, intervention and prevention. The same is true of project risk, where unfortunately the emphasis is also often on cure rather than on prevention, and sometimes also with fatal results.

This book argues that project risk management is not an optional activity. It is essential for the successful management of all projects. While formal project management has been practised for more than half a century, deliberate project risk management is not too common. For example, the accountant mentality might think that the decision to go through with a crime is based on the cost of getting caught, multiplied by the probability of getting caught, weighed up against the expected gain from committing the crime. In practice it seems unlikely that our criminals perform such calculations before deciding to visit that South Auckland dairy. The same could be said about going shopping or engaging in other risky activities such as base jumping and mountaineering. Why should our behaviour be any less risky with projects? Some suggest that our risky sports are a natural by-product of a risk-averse society in which such activities are the only legal route to express our biological instincts.

Project risk management is seldom done well. At best, most project risk management is a one-time subjective check of the plan by its author immediately prior to project execution, after which no further formal risk management occurs. After project implementation it's all crisis management. Yet in recent years the importance of project risk management has increased considerably due in large part to our rapidly changing world and thus the increasingly difficulty of predicting the future based on history. This exponential rate of local and global change is evidenced by:

- Our diminishing planning horizons, lead-times, and product life cycles.
- Our increasing obsession with speed, service, sustainability, creativity and innovation, driven by new technology and our customers' ever-challenging and changing expectations and their changing loyalties, which require that our organisations continually reinvent themselves, their products and services.
- Our burgeoning workloads – exacerbated by reduced staff numbers, more frequent staff changes, flattened hierarchies, marketplace competition, and fully impossible timeframes that have us move on before we have time to comprehend or even benefit from the last change.

- Our greater connectivity, cross-functional interdependencies and teamwork, geographically dispersed teams, growing use of contractors to complete our non-core work, and an increasing use of temporary workers.
- Continuous streams of more and more knowledge to be rapidly captured, understood, managed and shared. Apparently the amount of data being stored worldwide doubles every 18 months. It's sometimes called data deluge or cognitive overload.

Today's business environment is constantly changing. It is unpredictable, volatile and becoming more complex every day. By its very nature, it is fraught with risk. A common misconception about project risk management is that its purpose is to avoid such risk. In fact, the purpose of project risk management is simply to make project success more likely. No organisation can operate in a state of zero risk. Interestingly, some interpret our Health and Safety in Employment Act to mean do nothing unless it is entirely safe, which was never the intention of this legislation.

We also need to remember, while aspirations for doing better – returning to the top half of OECD standards of living, or achieving income equality with Australia – are fine, but aspirations are not projects.

Today we often have difficulty identifying where we might reasonably expect our business to go or wish to be in just four or five years, which is a concern when we are making decisions today about some expensive and longer-term investment project that may be destined to become another white elephant. Linton Army Camp is a local example of interest to me that fits this description. Although, presumably this closure project and relocation to RNZAF Base Ohakea will now be on the back burner. There are plenty of others. Let's hope that Greater Auckland doesn't become one such folly. And our big investment in ultra-fast broadband, a platform for economic growth, may have some risk, but essential surely.

Such uncertainty could understandably favour the selection of those projects that promise a quick and more assured return, and preferably a return within our CEO's term-of-office, a cynic might suggest. Or our project propositions might founder due to those very risk-averse CAVE, NIMBY, and BANANA stakeholder attitudes mentioned in multi-millionaire Mark Ellis's recent book.

There is also the NIMTOO (not in my term of office) decision, which might mean "a fine project for my successor."

While project selection is clearly a risky business, we project managers are more concerned with managing risk within our project once the project proposition has been approved. We are responsible for the output (project deliverable), but we shouldn't have responsibility for the success of outcomes (project benefits) over which we have no control. Some other learning points that this book expands on about managing risks within our projects are:

- Applying a proven project management methodology is essential. Risk management is then integrated with this methodology.
- Risk management is an integral part of good project management and to be wholly effective also needs to be part of the culture of our entire organisation.
- Risk management is not an exact science and sometimes the precise figures used may create an impression of accuracy that simply cannot be.
- Risk management is an on-going process applied throughout the project life cycle. Also, the effectiveness and efficiency of the risk management process itself needs to be continually reviewed and improved.
- The concept of risk tolerance needs to be understood and practised. Not all individuals and organisations show the same tolerance towards risk. Attitudes range from risk averse to risk taker.
- We should be careful about rewarding firefighters at the expense of rewarding fire-preventers. The firefighting syndrome can be a cultural impediment to proper risk management.
- Risk management should create value. It is a scalable activity. The benefits of project risk management should exceed the costs of doing so.
- The risk management process needs to be tailored to meet the unique needs of our organisation and must be responsive to environmental changes.

While risk management has always been important, it has gained much more traction in our current economic climate. Organisations, both private and public, are becoming more watchful and want to properly understand the risks that they're taking when planning new growth strategies, operational improvements, or other business and technology initiatives.

It is also important for our organisations to recognise that risk management is central to their ability to survive and thrive. They need to understand their risk tolerance levels and manage within those. Generally, those private enterprise organisations that are able to manage risk more effectively than their competitors do, have an edge in the marketplace. And non-profit and public entities will operate with greater effectiveness and efficiency.

One of the few certainties about projects is that they all involve risk, which needs to be planned for and managed in a rational and methodical manner. This book aims to demystify this discipline and show readers how to deal with project risk in a systematic manner. The chapters that follow are concerned with identifying, analysing, and responding to project risk, which requires we maximise positive risk events and minimise negative risk events to the betterment of our projects.

I trust you find the book useful and good luck in your efforts to subdue Murphy. Or perhaps I should wish you good luck and the wisdom to know how to manage it. It was Louis Pasteur who told us, "Chance favours the prepared mind."

Finally, I wrote this book during the most significant natural disaster in the history of modern New Zealand. It served as a constant reminder. The earthquakes and some 7,000 aftershocks have turned many people's plans on their heads. Gone is the business, the job, the house and in some cases, the breadwinner. I'm sure we all look forward to the resurrection of a stronger, safer and better Christchurch, to paraphrase the words of Mayor Bob Parker whose calm manner and commonsense advice has done much to soothe rattled nerves. The disaster has left an indelible mark on the collective Kiwi psyche. It would be interesting to zoom forward 30 years to see what our future Christchurch will look like. The CBD rebuild, replication, relocation or perhaps abandonment will be the country's biggest project. Meanwhile there are some 6,000 houses to be demolished.

Quake fixit czar, Roger Sutton, is likely to have a short honeymoon. He has a big job. Dresden took over 50 years to put right after Allied bombing. It took four years to clear the rubble at Hirsohima. Normalcy for Christchurch will doubtlessly return – slowly, fitfully, but eventually resoundingly. Frustration levels are certain to rise, but rebuilding is an amazing chance for renewal.

Somewhat overshadowed by the tragedies of the Pike River mining disaster and the earthquakes in Christchurch, the Rugby World Cup project provides us with an opportunity to focus on something much more positive and uplifting, although this too will have its hiccups on and off the field. May the best team win – this time surely! Our national mood is much synched to All Black fortunes.

In Memoriam – Rita Mulcahy, PMP

One of the world's top authorities and very popular project risk management author, Rita lost her battle with cancer on 15 May 2010.

Chapter One

Introduction

One of the few certainties about projects is that they will involve risk and because of this, those risks need to be planned for and managed in a rational and methodical manner. Thus, when it comes to successful project management, we need to understand risk and how to manage it to the advantage of our project. In the planning, implementation and completion of any project, big or small, an understanding of risk management and its practical application is now essential.

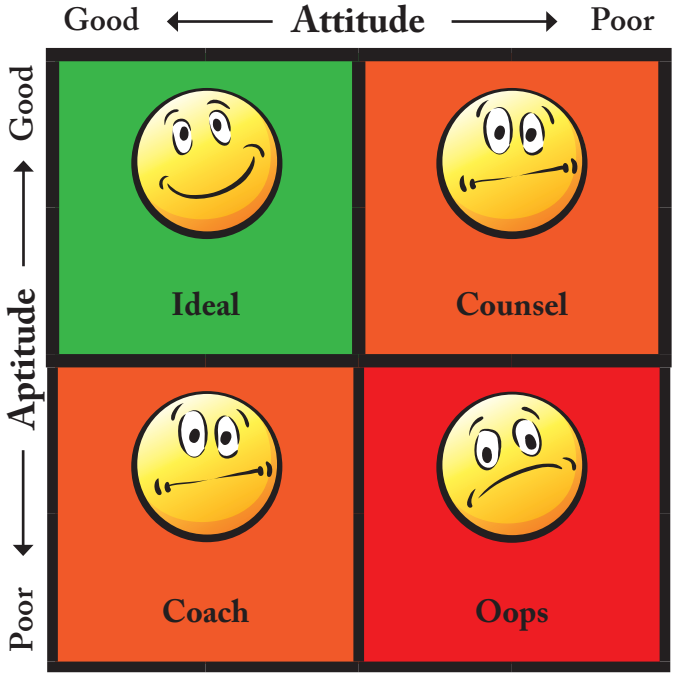
An important objective of this book is to provide you with a comprehensive guide to project risk management. The book aims to demystify the subject, although every discipline has its jargon. In our society to be illiterate is bad and nobody admits to it, but to be innumerate is readily admitted and seemingly very forgivable. In this book some mathematics is unavoidable, although the book is written for project managers, not mathematicians.

The book describes a generic risk management methodology that is cost-effective, systematic, easy to apply, and readily adaptable to any project regardless of its size, novelty, complexity, and type of project management approach used – PMBOK, PRINCE2, Agile and so on, not surprisingly all of which endorse the same risk management principles and employ similar straightforward processes, tools and techniques. The last thing we need is a tedious process. In fact, terminology is the only real difference among the various project risk management methodologies and possibly this difference is simply in an attempt to distinguish each from the other for mainly commercial reasons.

This book not only addresses the "how", but also the "why" of project risk management, since the greater challenge is usually persuading people they should do it. In my experience project risk management is something that is talked about

a lot but rarely done. Accordingly, the benefits of project risk management are the focus of this first chapter. Effective project risk management is probably more about attitude (will) than it is about aptitude (skill), although both are important. If we can't persuade our project people of the need to properly manage risk, then it's pointless they should learn how to do it. See Figure 1.1.

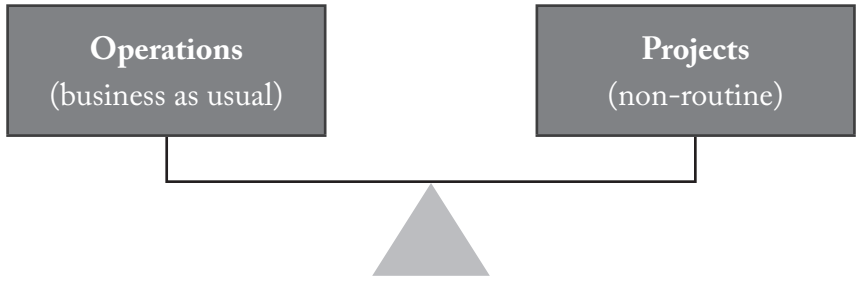
Figure 1.1 – Performance matrix



Projects are essential to the success of all organisations. There's no progress without projects, which can be risky ventures and more risky than repetitive operational activities. The distinguishing characteristics of each are summarised at Figure 1.2. Risks arise for many reasons. Some risks are internal or inherent to our project and some are external to our project, and both types of risks can considerably influence our project's success. Risk is a somewhat abstract concept and as such is a little difficult to clearly define, yet taking and managing risk is the essence of an organisation's survival and growth, particularly in a competitive environment. Risks are justified by the benefits that come as a result of taking them. Risk management might therefore be described as the process of optimising

the relationship between risk and reward. A certain amount of risk-taking is inevitable if our country, organisations and projects are to achieve worthwhile goals.

Figure 1.2 – Types of work



- Certain and safe
- Ongoing
- Repetitive
- Stable
- Easy to measure
- Established
- Maintains status quo
- Process-focussed
- Evolutionary
- Continuous improvement
- Harmony
- Work in the business

- Uncertain and risky
- Finite
- Unique
- Dynamic and changing
- Hard to measure
- Innovative
- Causes change
- Progress-focussed
- Revolutionary
- Once chance to succeed
- Conflict
- Work on the business

Project risk management is not a new concept. Official recognition of risk as a special concern of project management came in the late 1980s when the US-based Project Management Institute (PMI) first included risk management as part of its core Project Management Body of Knowledge (PMBOK). Since then a solid understanding of risk and its management has become a required item for

every project management methodology and in every project manager's toolbox. This growing importance of risk management is in part the consequence of our increasingly chaotic business environment. Also, with our current recession and political pressure for improved corporate governance, demand for better risk management is on the rise. Risk management is now recognised as an essential component of government, business and project success, since it focuses on addressing uncertainties in a proactive fashion.

The nature of project risk management continues to evolve. For some years now the project management profession has accepted that risk management is an essential, proactive and integral part of a project's entire life cycle, not simply a one-time, optional, tack-on activity. Also, it's now widely acknowledged that project risk management offers significant benefits to all organisations – established and new, large and small, public, private, and not-for-profit. Our major project management authorities, including the US-based Project Management Institute (PMI) and the UK-based PRINCE2 methodology owners, now advocate that project risk management be applied to both threats and opportunities. In adopting this inclusive definition we are consistent with the current trend in international best-practice risk management. We now use the same risk process to handle both threats and opportunities alongside each other, giving perhaps double the benefits from a single investment. Formerly, risks were regarded as only bad things – uncertain events with a negative impact on project objectives and/or benefits, and the perceived positives were simply the basis for project justification. Interestingly, other than for project management, risk is still widely regarded as wholly negative.

Perhaps no single event in recent history piqued worldwide interest in risk management more than the Y2K challenge. We recognised that when calendar dates changed after 1999, there was a danger of catastrophic computer failures. Also, in recent years phenomenal innovative software developments have particularly stimulated interest in risk management. Some of this software has helped us with risk management. For example, statistical simulation software has brought us the power of Monte Carlo risk analysis.

This book examines the origins of project risk, provides insights on why and how to manage it and prescribes a simple and structured framework for effective project risk management. The methodology supports the notion that not all risk is

bad, that in fact with risks we also encounter opportunities, although as Murphy's Law recognises, negative risk or threats seem more likely. Optimists may feel their project is exempt Murphy's Law, but experience tells us that Murphy visits every project, and while risk is a four-letter word, denial or the "she'll be right attitude" is possibly the biggest enemy to successful project management.

Managing project risk is essentially about increasing the probability and impact of positive events, and decreasing the probability and impact of negative events in our projects. Project risk management has also been described as the process of optimising the relationship between risk and reward. It's important that we aren't so risk averse that no risks are taken, because without risk there is no reward, innovation or progress. Thus, our fundamental objectives with contemporary project risk management are twofold:

- To increase the probability and impact of positive events or opportunities.
- To decrease the probability and impact of negative events or threats.

Opportunities are often the reciprocal of threats. For example, should a particular threat have a 70% probability of occurring we could reason that the risk's opportunity is then 30%. If an item of equipment has a 70% chance of late delivery, it therefore has a 30% chance of early delivery. Some refer to positive risk or upside risk as in a poker game in which some players also win money.

Risk is to projects what gravity is to the world around us. Risk is inherent in the process of managing projects. As with gravity, risk can be both beneficial and detrimental to our projects. Skateboarders use gravity to help propel themselves along. They also understand that the same gravity can cause them harm should they fall. Like skateboarders, project managers realise that risk exists, and it can have both good and bad consequences for their projects.

The 2010 Haitian 7.1 magnitude earthquake disaster killed about 230,000 people, some two million were left homeless, and many still remain destitute without shelter, healthcare or sufficient food. Apparently two years prior to this, a team of geophysicists, led by Eric Calais of Purdue University, predicted that the fault that produced this Haitian earthquake was at extremely high risk of doing exactly what it did – evidently a 50% chance within two years. They urged the Haitian government to strengthen critical buildings, including hospitals and schools. Failure to do so contributed to the toll.

Yet, sometimes it seems that people who advocate diet and exercise are kooks, and heart surgeons are heroes. For example, a fire alarm seems like a small investment compared to the possible consequences of a house fire. Yet our very professional Fire Service tells us that less than 60% of our New Zealand households have made this modest investment and of those installed, some 50% of the batteries are flat. Similarly, projects die every day, often the victims of risk neglect and malpractice.

Perhaps a percentage of the money raised for relief efforts, such as the Haiti earthquake, should be set aside to put right damage caused by future earthquakes? Of course a better answer might be to build quakeproof buildings in the first instance – a proactive approach that New Zealand attempts to follow quite conscientiously. I mention earthquakes as an example to remind us that anticipation is essential for effective risk management.

Brian Tucker, an earth scientist who leads GeoHazards International, suggested that 10 per cent of the money going to help the Haiti rebuild programme should be dedicated to mitigating the destruction in earthquakes. But he knows from many years of sounding warnings that most people are complacent about catastrophes that are yet to happen and after they happen it's too late to worry about them. Although of course the people of Haiti might prefer to eat than invest in quakeproofing their buildings. It is a very poor country.

About 403 million people live in cities that face significant seismic hazards, according to a recent study by seismologist Roger Bilham of the University of Colorado. One of those cities is Wellington, New Zealand's capital, where we're probably better prepared than most. However, in many of these vulnerable cities, people are effectively stacked on top of each other in buildings designed as if earthquakes don't happen. It's not the tremor that kills, but the buildings routinely constructed on the cheap, using faulty designs and, in some cities overseen by corrupt inspectors. The difference between life and death is often a matter of how much sand went into the cement mix or how much steel went into a supporting column. Earthquakes might be acts of God, but their lethality is often a function of masonry. Bilham tells us that in recent earthquakes, "buildings have been weapons of mass destruction."

Then seven weeks after the Haiti earthquake, an 8.8 magnitude earthquake hit Chile. This was far stronger than the one that struck Haiti – yet the destruction

and death toll in Haiti was much higher. In the Chilean earthquake some 550 people were killed and about NZ$40 billion of damage occurred. The main reason for the relatively better outcome is simple – many Chilean homes and offices are built to ride out quakes, their steel skeletons designed to sway with seismic waves rather than resist them. In Haiti, by contrast, there was simply no building code.

However, many Chileans complained that scores of deaths could have been avoided had their government responded faster to the earthquake, which set off a roaring tsunami a few hours later that killed several who survived the quake. According to one survivor, Manuel Parra, "Those who ran up the hill survived and those that didn't are no longer here." In this instance risk prevention was not too bad, but the contingency plan was absent. The human and economic cost could have been a lot worse if Chile didn't have a building code.

In contrast, here at home, on 4 September 2010, Christchurch suffered a major earthquake, of the same strength and at the same depth as the one that killed an estimated 230,000 in Haiti earlier in the year. However, although both quakes were near population centres, our local quake caused no deaths and had much less collateral impact since it occurred at night and because steps had been taken beforehand. The newer buildings in Christchurch had good quake designs, unlike Haiti where there were no quake designs. In fact, this was the first time in modern history a 7-plus quake had hit an urban centre with no deaths.

Most homes in New Zealand are generally timber-framed and will flex and absorb quake energy, and new commercial buildings are constructed with isolating foundations. Yet there have been some New Zealanders who have previously caviled at the earthquake standards now imposed on our buildings, claiming they are excessive and bureaucratic, that the standards are being set too high, and that they can force unnecessary expense, renovation and demolition, particularly in areas not known for earthquakes. Surely our recent experiences should silence these critics. Risk has been managed through building codes, resilient infrastructure, earthquake insurance and individual precautions.

On that occasion our rigorous building codes undoubtedly paid off in lives saved. Victoria University's Professor Martha Savage has pointed to New Zealand's building code as the key factor in the difference in outcome between the Christchurch quake and that in Haiti. It's all too easy to become blasé about the risks of living in the Shakey Isles. We should be grateful to live in a country that can afford earthquake precautions and the repair costs.

At first we anticipated that Christchurch would be back to normal or even better within two or three years. However, there was a lot to put right. According to Tony Marryatt, Christchurch City Council Chief Executive, this included 100km of sewer pipes, 18km of water mains, 45km of roads and 161 parks that needed repair, at an estimate of more than $500m. There was also repair work to do on buildings. But, on 22 February 2011 Christchurch suffered another, and even more, destructive quake. The central city is currently in ruins after a magnitude 6.3 quake, just five months after what now seems like the dress rehearsal or practice run. However, this latest quake has caused the carnage that Christchurch thought it had missed. The city was just learning to relax again and now it resembles a battle zone. The Government has declared a national emergency, help is here from many countries, and the death toll has climbed to 181. It might have been less on the Richter scale than the 4 September quake, but was significantly shallower and closer to the city, resulting in much worse impact.

This will now be a multibillion-dollar repair job, perhaps $18 billion or more (about the same size as our national debt or the cost to put right our leaky homes). Our ECQ fund will be exhausted. There are already some 400,000 claims. It's an insurance nightmare. Thankfully, this is New Zealand and not Haiti, so there will be rebuilding. Although, as our PM John Key reminds us, "In the end buildings are just buildings, roads are just roads, but people are irreplaceable." Mr Key has (again) consummately combined uplift with realism. He is at his best in awful times.

In New Zealand, earthquakes are unavoidable. However, this latest event again demonstrates the value of quake-proofing to minimise damage and contingency planning. These risk management strategies are investments, not a cost.

That is the beauty of living somewhere like New Zealand – unlike Haiti or Pakistan where cities stay largely as earthquakes leave them, and where the governments cannot afford to provide electricity, let alone give aid to people whose home has suffered damage. Many such places have no power or clean water all the time. In fact, now, Haiti faces widespread cholera.

Although this book is not intended to explore earthquakes, having mentioned Christchurch's problems, on 11 March 2011 Japan suffered an extremely devastating 8.9 magnitude quake and tsunami with the possibility of some 15,000

deaths, multiple nuclear power stations meltdowns and the release of dangerous levels of radiation, to be the world's worst nuclear crisis since Chernobyl in 1986. And in New Zealand, fears have been raised that our mutton birds, which migrate through Japanese waters, will be glowing with radioactivity when they return here! Although, I notice that world media and Fukushima alarmists proclaim its a nuclear and ecological disaster much worse than Chernobyl. Seems improbable. Incidentally, their heavy reliance on nuclear energy seems ironic given their experience of being the first human targets of atomic warfare in 1945. Fortunately, New Zealand can't afford and doesn't yet need nuclear power, although thousands could die if our hydro dams burst. The main difference being that people die faster in a dam burst. However, in due course we will probably need nuclear power if we are to avoid burning fossil fuels or building more dams. The alternative being we relearn how to shoe horses and milk cows by hand, although I read that a thorium reactor from China might be a better solution.

The Japanese death toll seems likely to exceed 15,000 and coastal towns look like mangled debris. Actuaries will be reflecting on their risk assessments and are perhaps wondering if the Japanese quake was triggered by the Christchurch quake. Anyway, it was great to see that a Kiwi urban search and rescue team left for Japan immediately.

Some may argue that these examples are national-level Force Majeure situations and therefore not particularly relevant to projects. Force Majeure occurrences include earthquakes, meteorites, volcanoes, floods, civil unrest, terrorism and such like – all beyond our control as project managers. Nevertheless, these recent disasters provide a graphic illustration about the need to be prepared – the essence of risk response planning.

Project management is about managing risks in projects, which was never intended to deal with disasters for which organisations should have business continuity and disaster-recovery plans. Also, some contend, outside the scope of project risk management are everyday risks that can occur on any project, such as, "We may lose a team member during the project" or "The client may wish to change the project scope." We have standard operating procedures and project processes to address these routine matters. They do not usually need to be recorded in our risk register, although if unsure, better to record it.

At organisational level our CEO and senior managers would typically consider risk and risk management, but not so closely at project level. Ideally, they shouldn't be worrying about a project's risks, unless something comes up on the project that has such big impact that it affects business continuity. At our level, as project managers, we manage project risk. In fact, the application of project management is risk management. Programme managers manage programme risk, and CEOs and senior managers manage portfolio and strategic risk. CEOs mainly think about risks to things like profitability, reputation and market position. They are constantly looking ahead, trying to predict the unpredictable.

We each manage the risks to our assigned goals. Nevertheless, before a possible project becomes an actual project and is formally assigned a project manager, the proposition should have been subjected to some strategic risk scrutiny, otherwise it may be another Titanic on its way to disaster, while some hapless project manager is doing their best to straighten the deck chairs, as the saying goes. As you probably know, the "unsinkable" Titanic, with some 2,000 passengers and crew, and lifeboat capacity for about 1,000, struck an iceberg on its maiden voyage on the night 14 April 1912. Over 1,500 people lost their lives. It was the 9/11 of its time. While the Titanic came to grief, ironically, the 1997 film project by the same name was six months' late, massively over budget and finished with a bloated 194-minute running time, yet was an amazing commercial success and won eleven Academy Awards. A project is underway to convert the film into 3D in time for the 100th anniversary of ship's sinking. No risk – it will be another blockbuster.

Once a project is approved, the project manager then checks primarily for tactical or project risk, the management of which is the project manager's responsibility and the focus of this book. It's about looking ahead or forecasting and typically looking further ahead and spending more time doing so than anyone else on the project team.

A witty and perceptive former prime minister of New Zealand, David Lange, compared forecasting risk to driving a car forward by looking only in the rear vision mirror. It's a hazardous business, yet what has happened previously, history, is still our best predictor of the future, especially when we're thinking about what risks our project might hold. I would like to add to this metaphor by saying that we're also driving in rush-hour traffic with road-enraged, fist-shaking lunatics in

four-wheel-drives. And we have a cracked rear vision mirror and dirty windows, with a back seat full of kids who keep asking when we will we get there. This is real-world project management and the voices we hear are likely to be key project stakeholders whose expectations of spot-on-time arrival are in jeopardy.

A precise estimate to the nearest hour or dollar only raises stakeholders' expectations about the degree of accuracy possible. This can lead to perceived failure when such unrealistic exactitudes are not achieved. They may not understand that an exact estimate is an oxymoron, whereas we know that our raw estimate has about an equal chance of being too much as it has of being too little. This is reality in the uncertain world of project risk management where Murphy's Law reigns supreme.

Estimating is difficult but it needs to be done in order to assess a proposed project's acceptability and provide a baseline against which to gauge project management performance. Estimates also serve as a useful target for the project manager, although estimate accuracy generally improves as the project proceeds when previously unknown and unknowable factors become evident. Unfortunately, we can't predict the future with much accuracy and life is a chancy thing. Also, project scope changes. Such changes are due to external factors, client indecision, new technology, incorrect assumptions, poor original planning, and in compensation for changes to other parameters, such as budget cuts.

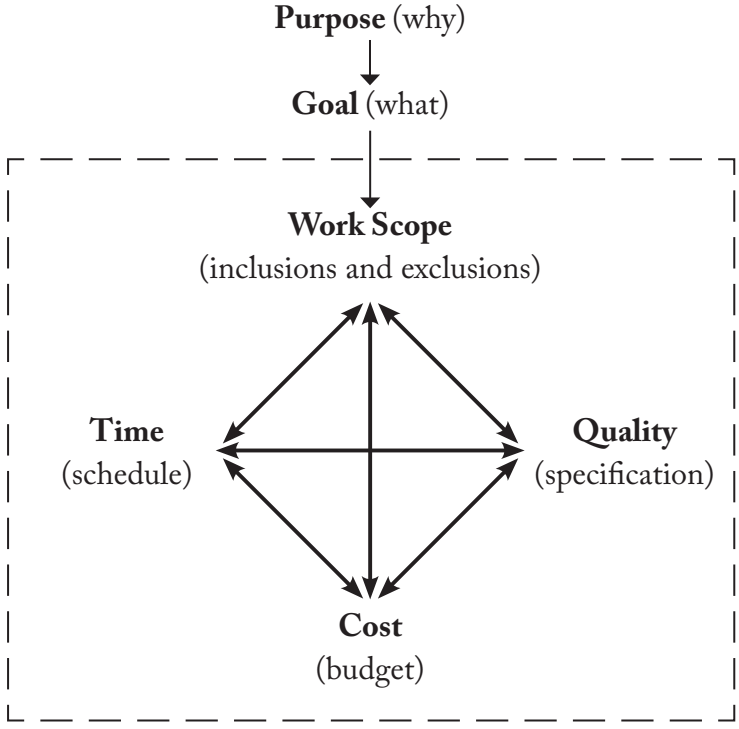
Risk is part of everything. It's a pervasive reality that arises because we live in a world of uncertainty. There's always some level of risk in our projects, regardless of what our pristine Gantt chart proudly pinned to the wall might seem to imply. Although Gantt, named after its inventor Henry Gantt, is sometimes considered to be an acronym **G**od **A**lone k**N**ows **T**he **T**ruth. Projects, like life, possess their fair share of risk or sometimes more than their fair share. Yet, the zero-risk project, if one existed, would not be worth pursuing.

Risk is particularly prevalent in projects due to the uncertainty associated with such unique and often pioneering endeavours. Project risks arise from uncertainty, but not all uncertainty means risk. In the project management profession, uncertainty only matters if it affects us achieving our project objectives. It is this link with objectives that makes risk particularly relevant to projects. See Figure 1.3. In contrast, operational, business-as-usual, routine work generally has had all or most risk squeezed out of it as part of continuous improvement practices. Such

repetitive work usually has little uncertainty, holds few surprises, and the output is readily predictable and usually of a consistent quality. However, a project gives us just one opportunity to get it right, and given that we project managers are perishable items who are often deemed to be as good as our last project, a proactive or preventative risk management approach is preferable to a reactive approach, although effective project risk management usually requires both a fence at the top of the cliff and an ambulance at the bottom.

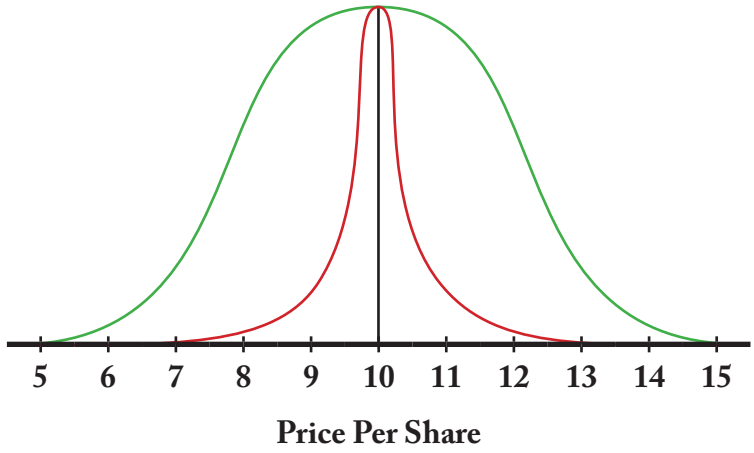
Uncertainty might be described as a measure of likely deviation from what we expect or desire. It's a measure of variability. Consider the market performance of two shares. Share X's price might average $10 during the year, with a lowest price of $7 and a highest price of $13 per share. Share Y's price also averages $10, but varies over the same period from $5 to $15. From an investment viewpoint X is the safer proposition. It has less variability and thus less risk than Y. These are both examples of normal or bell-shaped probability distribution curves, but one shows greater uncertainty. See Figure 1.4.

Figure 1.3 – Project objectives



If these were two projects, the average or mean duration would be the same, but the range (statistical variance or standard deviation) of expected durations is different. The value of such frequency distributions in predicting results is embedded in PERT (programme evaluation and review technique) a formula developed by the US Navy in 1957 and first employed during the Polaris Missile programme. It's a method of estimating the cost or duration of a project or project task, or material requirements that are subject to uncertainty. The PERT formula is the basis for @Risk and other risk assessment software used in project risk management, and is considered further later in this book.

Figure 1.4 – Probability distributions



To appreciate the range of risk possible in our projects, we can picture a continuum ranging from total certainty to total uncertainty. With total certainty there's no risk, since there is no variability. With total uncertainty, everything is unknown, and as a consequence risk is extremely high. All projects fall somewhere between these extremes.

Risk is a pervasive reality in project management, and projects are particularly susceptible to risk because each project is unique at least in some measure, which means that the past is an imperfect guide to the future. We are never completely sure what the future holds and it's only at the end of the project that we know for sure that we have a disaster or hopefully something much better. Up until then it's often guesstimates and assumptions, which we need to continuously review

and update as reality unfolds and as things go bump in the night. There are always plenty of risks lurking in assumptions. Also, project requirements and parameters, or the environment in which the project occurs, is never considerate enough to stand still while we plan the work and work the plan. Projects are dynamic things and any business case, project plan or budget estimate is simply a best guess and a baseline for change and improvement.

But is project risk management worth it? Some project managers skip the risk management process, perhaps because they're unsure how to do it or more likely they aren't convinced of the need for it. Also, the sponsor or other influential stakeholders may want the project to start immediately, without the project manager and team becoming preoccupied with potential problems, thus wasting time and money, and procrastinating over things that have no certainty of happening that can be dealt with when and if they arise. Yet, an important added value of effective project risk management is ultimately less cost and/or more profit, achieved by:

- The reduction or elimination of project threats, such as not employing an unsatisfactory contractor.
- The exploitation of opportunities, such as the addition of an extra product feature that disproportionately increases product sales and profits.

An appropriate and mature risk culture enhances an organisation's ability to successfully undertake innovative and complex projects. Increased predictability, openness about and control of project risks, reduces costs, stress, firefighting and overtime, which is otherwise needed to resolve unanticipated problems. Some further potential benefits of effective risk management are:

- fewer project issues
- more opportunities realised
- overly risky projects terminated early
- more realistic project estimates and plans
- more project benefits realised
- improved reputations for all involved.

The added value of project risk management will also depend on the nature of the project. The riskier the venture, the greater is likely to be the added value of risk management. A somewhat notorious New Zealand Police project (INCIS)

undertaken by IBM in the 1990s provides a useful acronym for some key constituents of high project risk.

INCIS wasn't just a new mega-project for the project team and organisation, but new for our country and possibly new for our world. If each of these risk factors is present in our project, and each factor had the potential to reduce project success by say 80%, then the compounding effect of these risks might mean that we have only a 33% likelihood of success (0.8 x 0.8 x 0.8 x 0.8 x 0.8).

I – Imprecision (unclear parameters)

N – Novelty (unique endeavour)

C – Complexity (many diverse components to coordinate)

I – Inexperience (lack of relevant knowledge and skills)

S – Size, scope or scale (big job)

These five items aren't the only risk factors in projects. In fact, size alone does not create more risk, usually just bigger ones. Novelty is most certainly a very influential factor, since risk is lowest when we revisit familiar ground. Also, complex projects often involve significant levels of uncertainty. When the business problem or opportunity is unclear, it is difficult to identify stakeholders and define business benefits, and establish project boundaries and estimates. Some other important risk factors include the organisation's level of risk management maturity, senior management support for the project, project priority, project intensity and duration, location, assumptions and the three As of project team human resource productivity – attitude, aptitude and availability.

Project duration is a risk factor insomuch as the longer the project's lifespan, the greater is the project's exposure to changes and risks, especially those arising from outside our project and also from outside our organisation. Such changes include inflation, market conditions, competitors' activities, cost increases, resource shortages, political uncertainty, earthquakes and changing weather patterns – all or at least some of which are likely to occur concurrently.

In one form or another, we have practised project risk management for millennia, yet today, project risk management is a much greater challenge and necessity, mostly because the future is becoming less and less predictable as we suffer or benefit from unprecedented rates of change – ironically mostly due to projects, which of course upset the status quo in the name of progress. I'm reminded that several years ago when I occasionally facilitated strategic planning sessions, the planning horizon was measured in decades, while today it's hard to know where anything might be in a mere three to five years. Although, our government is obliged to look at least some ten years into the future. No doubt they need to update their predictions frequently to accommodate the change reality.

This uncertainty particularly challenges decisions about long-term projects and probably favours those projects that promise a quick return before everything changes too much, at least within our current CEO's tenure in order they might justify their sometimes obscene salaries the cynic might suggest. Interestingly, our Treasury experts have recently published a 40-year fiscal projection, although none of them are likely to still be in office by then. They too must surely recognise the increasing importance of risk management due to our rapidly changing and interconnected world and thus the difficulty of predicting or projecting the future based on history. Exponential change is the new norm, current global recession aside, evidenced by:

- Diminishing planning horizons, minimal lead-times and shortening product life cycles. We want it today even with its faults. Version 2 may later sort out these deficiencies. Has time now exceeded quality as the top project parameter? If we wait until it's perfect it may be too late for the market. But, given current rates of obsolescence, perhaps the product doesn't need to last too long!
- An increasing obsession with speed, service, sustainability, creativity and innovation, driven by new technology and customers' ever-challenging expectations and changing loyalties that require organisations to continually reinvent themselves, their products and services. There's also an amazing proliferation of products – varieties of toilet paper, toothbrushes, milk and bread come to mind.
- Burgeoning workloads, exacerbated through reduced staffing, staff changes, flattening hierarchies, increasing global competition, and impossible

timeframes that seem to have us move on before we can fully comprehend or benefit from the last change.

- New products, which are likely to be obsolete before we leave the shop. This, I noticed very recently, seems especially so with razors. They're only good for this month's razor blades. I find this frustrating rather than exhilarating. Also, with the latest shaving innovation – Gillette's Fusion ProGlide evidently designed by a former NASA scientist – hitting the market, one thing hasn't changed, they remain ridiculously expensive.
- China has leapfrogged Japan to become the second-largest economy and its 9.5 per cent growth is a sharp contrast to most developed nations. As deflation eats away at iconic Japanese firms such as Sony, upstarts like South Korea's Samung Electronics are booming. There is no competing with China as the United States sheds jobs, Europe unravels and Japan's deflation deepens, although India is zooming along at 7.7 per cent. The Anglo-American model of capitalism seems due for a shake up.

More and more project managers are becoming successful CEOs since experienced project managers have the requisite cross-functional credibility. They know about the loneliness of command, single-point responsibility, and are accustomed to leading teams over whom they have little or no authority. To get results they must rely on who they know, which is largely about corporate politics, something every prospective CEO needs to understand. Incidentally, the culmination of those earlier strategic planning sessions was typically an impressive looking glossy that was often consigned to the bottom drawer and had little influence on project selection. Strategic planning was likened to a corporate rain dance that we insisted on doing, yet it had no influence on the weather.

However, now we better recognise that any value-adding project must have strategic alignment. The project must contribute to the realisation of our organisation's vision, mission and goals, and it must also fit with our core values, which unlike goals, aren't usually prioritised and may not give us direction so much as enable us to assess the correctness or appropriateness of our projects and how we go about them. It's practised values, not published values, that help determine the culture of our organisations, and sorry to say, not all cultures favour risk management, which is usually a reflection of senior management's attitude and actions that we may then emulate throughout our organisations as local best

practice. We will not have very effective project risk management unless our senior management "talk the talk and walk the walk", since bottom-up change is usually much harder to achieve.

There is no progress without projects and it seems likely that they will occupy more and more of our time given world-wide increasing demand for new products and services, temporarily slowed by our current global recession, which of course has had some organisations reaching for the project axe. Yet, our Reserve Bank governor recently told us (December 2010) that the recession is over. Perhaps he needs to share this good news with our thousands of newly unemployed. I'm a consultant and that's now proving to be a euphemism for unemployed – hence the opportunity for this book-writing project. A local economist has described the current downturn as "a fluctuation about an inexorable growth trend" prefixed of course by "everything else being equal." One certainty is that our new television or laptop is already obsolete. Products are proliferating and their life spans are shrinking. Projects are increasingly time-driven often in our anxiety to get to market first to satisfy our impatient customers. Such speed can further exacerbate project risk particularly when it affects deliverable quality. While we don't condone perfectionism, lack of quality may mean:

- Rework, which is about redoing the same job because the original effort was unsatisfactory. Rework in turn causes missed deadlines and an overspent budget, which then causes business value to be delayed or reduced.
- Higher on-going maintenance and support costs for the final deliverable.
- Unhappy clients from whom there will be no repeat business.
- Reduced productivity due to poor morale resulting from unhappy clients and the need to continuously repair deliverables.

Project managers are usually under pressure to deliver, but we can't do everything ourselves, although we still have to make sure everything is done. While we await the cloning solution, some organisations could well increase their interest in project risk management and its application. Our best project managers will then be able to succeed more often, and our organisations will come out of the current economic doldrums stronger than they were before.

Meanwhile, organisations and project managers should not be afraid to take on challenges. For those who have turned around projects through effective risk

management, their futures are assured. In every sector, the ability to manage risk is a much prized skill, so project managers should be ready to capitalise on the good as well as the bad projects. Effective project managers have the courage to push back against arbitrary budgets and overly optimistic deadlines to negotiate realistic win-win parameters for their projects.

But it's not just our competitors and internal factors we need worry about. More than ever, our projects are at the mercy of external factors beyond what competition might do, and mostly beyond our immediate control. Such factors include our local and global environment with increasing emphasis on sustainability, economics, financial markets, technology that usually sets the pace, politics, legislation, climate, earthquakes, social and cultural considerations – all subject to unpredictable change. Very occasionally these external factors might conspire to make our projects more successful than they deserve to be, but that's luck, which helps, but is not a sensible basis for responsible risk management.

Most practitioners recognise that project risk management is no longer just an optional extra and that it is now an essential and integral part of the entire project management process from project conception onward. A few other recent changes to our project risk management philosophy are:

- Not all risk is bad. Yes, risk can provide opportunities as well as threats to our project. Risk is, after all, uncertainty and a mere possibility. It's a bit like indulging in the stock market. If we buy shares, we take a risk. Our shares may go up in value as well as down. Variability is a two-sided thing, since variables may go both up and down. For example, team productivity, weather, and cost could be different either way than estimated. The point is – risk can be positive or negative. However, not everyone subscribes to this relatively new definition. They argue that opportunities exist only in the respect that they offset a larger body of potential negatives and a term such as positive risk or upside risk is simply an oxymoron reminiscent of George Orwell's 1984 politically correct redefinitions. However, this author accepts that risk is "uncertainty that matters" and is the consequence of exposure to uncertainty, which surely covers the possibilities of both negative variances (threats) and positive variances (opportunities). That is, risk is something that could happen, and if it does happen, may have a positive or negative impact on our project. Could happen means a probability of less than 100%. If it has

a probability of 100% it's a fact – a definite issue. But a risk must also have a probability above 0%. Including opportunity in the definition of risk is a natural consequence of recognising that projects are affected by uncertainty, some of which might be helpful.

- Ultimately, project success is about adding value by realising business case benefits – those that justified our project investment. Thus, we must not only address the impact of risk on our project's objectives, but also apply risk management to our anticipated project benefits, which often possess more uncertainty than do project scope, cost, time and quality parameters. Developing and maintaining the project business case is usually the project sponsor's responsibility. Project managers concern themselves with risks to project management success. We generally let the sponsor worry about the viability of the project deliverable as argued in the business case. The sponsor's responsibility intrudes into the project product life cycle, whereas our formal responsibility as project managers is usually confined to the project life cycle. Once the final deliverable is produced our attention is usually focused on our next project or on our other projects.
- Project risk management starts early. Coupled with the above point, we're generally proficient at dealing with risk after project approval and at least up until project implementation, but risk analysis also needs to be considered as part of the project selection process. An effective risk analysis at an early point can quickly weed out potential duds and help us avoid wrong projects. After all, it doesn't matter how efficiently we as project managers execute the wrong project, if it's still the wrong project. Again, project selection is not usually the project manager's decision.

Just a few more words about the project business case. It is the objective rationale for the project that considers both anticipated project benefits and costs, which might be immediate and longer term, direct (primary) and indirect (secondary), qualitative (hard to dollarise) and quantitative (easy to dollarise), and each with different risks and likelihoods of occurring – assured, probable, possible or unlikely. It's the project sponsor's job to undertake or arrange with a business analyst for this assessment. The sponsor owns the business case and is ultimately responsible for ensuring that project benefits are realised. The sponsor's interest in the project must therefore extend into the operational life of the deliverable. Sometimes the

prospective project manager is required to prepare the business case or assist with its preparation.

Developing a business case is not necessarily an easy job (particularly for longer-term projects) and is based on assumptions and predications that may be inaccurate. Also, a business case should be an ongoing assessment, reviewed and updated periodically throughout the life of the project. Changing circumstances might mean that the project is now not needed, is unlikely to achieve its purpose or add value, or has a negative profitability index (revenue/costs) and should be stopped and resources used elsewhere. This usually is a difficult admission for project sponsors and other advocates, but unless future benefits continue to exceed future costs (regardless of sunk costs) it's time to quit.

A sensible place to start this book is to define risk – but this is not so easy. To most of us risk seems like something bad, and my daughter's school dictionary confirms this notion, describing risk as "The possibility of incurring misfortune or loss." But, as I mentioned earlier, in recent years there's been a paradigm shift in the project risk management thinking. The somewhat conservative Project Management Institute (PMI), currently our foremost professional body in project management matters, now describes project risk as, "An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives." We should be happy enough to go along with this definition, even if at first glance positive risk seems to be a peculiar expression, since to do otherwise might mean we get preoccupied with the bad things to the possible detriment of stakeholders' morale and motivation, and more importantly we might then miss out identifying and exploiting opportunities – the good things. We might say it's about getting the risk out of opportunities and exploiting the opportunities in risk.

To illustrate – say company A announces that it is most likely to launch its new project in a few weeks. It's rival, company B, is also undertaking a project to produce a similar product, and realises that every day they launch earlier than company A, the bigger will be their initial market share and profit. However, they also realise that every day they launch later than company A, the smaller will be their market share and profit. Thus, a positive outcome of this risk is that if fear of late release causes company B to accelerate their schedule and complete

their project even one week earlier than does company A, then risk management should provide a positive outcome for company B.

We must not conceal threats to our project's success just to keep project people temporarily happy, persuade contractors to sign up, or to protect the viability of our pet project. That sort of behaviour is crazy. Yet on the other hand, we don't want to be non-stop merchants of doom and gloom, and "white ant" our own projects. Sometimes risks become self-fulfilling prophecies and overstating risk might see our project idea or request dismissed before its feasibility is ever objectively assessed, or it might be that disproportionate amounts of resource are devoted unnecessarily to managing over-estimated risk.

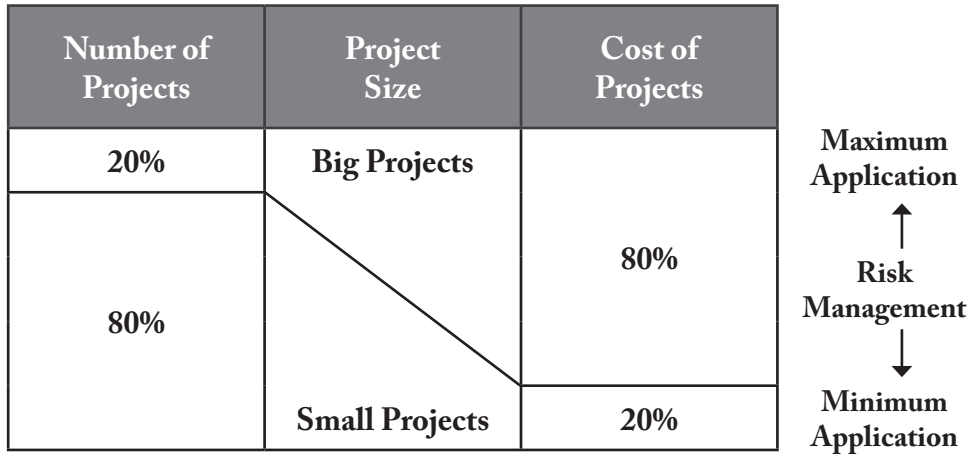
It's sometimes argued that risk finding encourages a negative and overly cautious attitude. Also, Parkinson's Law states that work expands to fit the time available. Relating this to projects, if we add extra time or money to counter or exploit risk, then naturally some project managers will fill out the extra time and spend the extra money regardless of risk. Conversely, neglecting risk management and having no contingency are common causes of project failure. It's a matter of balance.

We also need to recognise that the amount of time and effort we devote to risk management is largely a function of our project's scale, cost, duration, novelty, complexity and consequences should it fail. See Figure 1.5. These are principal factors that influence project risk. To which we might add inert sponsors and La La Land project parameters. Our organisations can minimise time and effort by applying risk management right from the start using a project selection process that quickly eliminates project propositions that are too risky, before there's any significant investment at stake. Also, one of our first actions as a project manager is to establish a risk register in which all stakeholders can document risks to the project. Project risk management, as with safety and quality, is everyone's concern and it starts as soon as possible and continues for the duration of the project life cycle.

A solid understanding of the risk management discipline and its application is most definitely a required competency for modern project managers. No seat-of-the-pants, ad hoc, shoot-from-the-hip, wait-until-it-happens approaches should be tolerated. In essence, project management itself is risk management,

and in some way all of our project management processes, tools and techniques help minimise uncertainty and enhance the likelihood of project success. In fact, a validated project management methodology is an essential prerequisite for effective project management. An effective methodology ensures that everything that needs to be done is done and in an appropriate sequence. However, many organisations approve more projects than they can deliver. Such organisations need to leave more projects behind at the beginning and fewer behind at the end. To remove the backlog we need to more conscientiously decline bad ideas, decline projects that can't be started soon, and decline projects that lack sufficient resources.

Figure 1.5 – Risk management application



Unfortunately, increasing uncertainty is the new norm. Worldwide credit woes, global recession and climate change all look like being with us for the foreseeable future. Yet somehow we adapt and projects forge ahead. We're gradually becoming more comfortable with the uncomfortable. We can't wait for the world to right itself, so we're adopting new models for project management that will make our projects more efficient, agile and flexible, better able to survive the present, and better positioned to thrive when and if, normalcy returns. All such new models recognise the great significance of risk and the vital need for its proper management.

Agile (Scrum, Lean, Custom, Hybrid etc) software development projects welcome changing requirements, even late in development. Agile methodologies are ideally suited to those very uncertain projects where there are rapid changing or highly emergent requirements. Good ideas are welcomed at any point. There are no premature design freezes.

With Scrum for example, project progress is via a series of iterations called sprints where value is added progressively. Simplicity is emphasised, and at regular intervals, the team reflects on progress and identifies how to become more effective, although scope creep can sometimes proliferate and estimates may escalate. Then again some would maintain that Agile methodologies were developed to allow IT projects to indulge in scope gallop without guilt. Research suggests that software projects fail for a variety of reasons, but often they fail just because:

- Work took longer than expected.
- Requirements keep changing in an uncontrolled fashion.
- Things came up that nobody expected.

Often these causes would be valid, but I suspect that sometimes they are excuses to cover up an absence of basic planning and forethought. Perhaps Agile methodologies have become more popular because they compensate for the lack of foresight and longer-term planning that seems to be characteristic of many larger IT projects. The cynic would tell us that Agile is the answer for those IT projects, which they describe as, "Endeavours initiated by people who can't describe what they want, constructed by people who can't describe what they do, and delivered to people who can't understand what was built or how to use it."

Nevertheless, the incremental approach seems appropriate for high-tech pioneering projects in our rapidly changing project environment. The key characteristic being smaller steps, all of which we plan on a just-in-time basis, somewhat similar to PRINCE2 stages, rather than the more conservative model whereby we might attempt to prepare the plan for the entire project before any implementation. This latter approach usually means that the plan needs constant revision as we proceed, mostly due to future uncertainties, the more of which appear the further out we attempt to plan. The expressions sometimes applied to this iterative approach are progressive elaboration or the rolling wave strategy whereby we define something broadly to start with and then in more and more detail as we proceed with the project.

Agile methods might best be described as focusing on adapting quickly to change, attempting to minimise risk by developing software in short time-boxes, and only building what we need, when we need it. Each iteration or sprint is a short project of its own, which means we don't have to invest a lot before we discover we have the wrong project or approach. In fact, while we would like some early successes to help ensure stakeholder buy-in, where practicable, it might be more sensible to tackle the most risky stuff first before there has been significant financial investment. Conventional models seem to believe that everything will stand still while we undertake our project, and we can work out everything we want to do before we start. But we then discover by the time we have started, requirements and other things have changed, and yet we might sometimes go ahead with the original plan anyway to the eventual dissatisfaction of all stakeholders.

Using Agile methods, each iteration is a miniature project of its own, and includes all the tasks necessary to release an increment of new functionality – planning, requirements analysis, design, coding, testing, or documentation. Thus, the argument goes, instead of finding out we have backed the wrong horse at the end of the race, Agile allows us to pull out or change horses early on to get a better result.

In an Agile risk-driven approach, the project team performs risk management activities before starting development work within an iteration. Agile risk management practices must address two issues:

- They must successfully integrate risk management activities into the iterative planning activities.
- They must adapt risk management practices so that the entire team can perform them quickly.

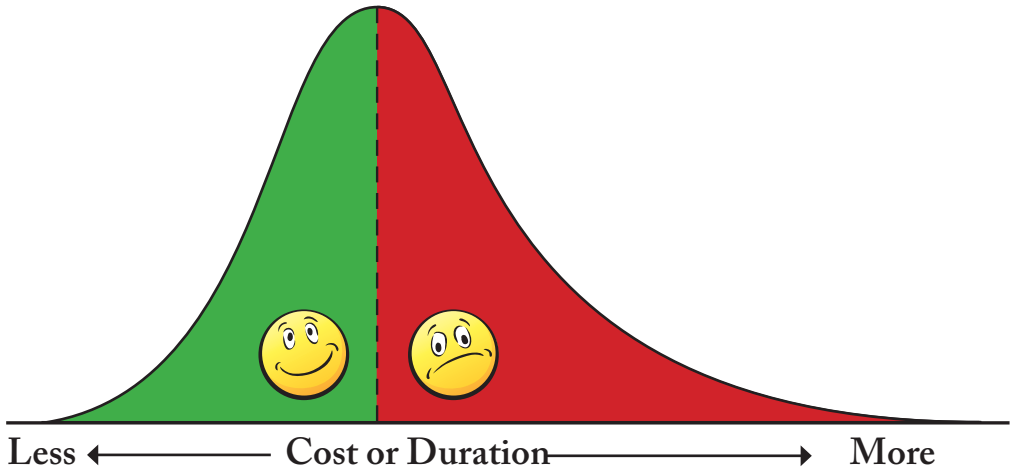
Typically Agile project risks include product managers' lack experience in creating user stories, product managers located remotely, team members not assigned full time, providing functionality competes with delivering high quality, software production unstable, etc.

Also, we can apply Agile principles within a waterfall project setting. Clients prefer a fixed or approximated budget up front. Deliverable groups can be set in a timebox to provide workable functionality for the client.

While there is a difference between Agile methods and traditional waterfall methods, this difference isn't so much as we might think. The traditional method results in a longer plan, but that plan is broken into smaller chunks and interim deliverables, not too unlike Agile sprints. With Agile, the argument goes, we manage risk as we undertake the sprints on a regular and short term basis. In practice there can be lots of backlogs piling up for the next sprint and causing the same level of uncertainty/risk that occurs in traditional waterfall project management.

Uncertainty means risk. Uncertainty also means that our estimates, on which our project selection decisions are largely based, are statistical probabilities, and variance, the difference between planned and actual, is inevitable, but hopefully within acceptable and predetermined limits of tolerance. In fact, risk is a measure of the extent to which a given result might deviate from what is expected or desired. Such deviation could be for better or worse, but generally for worse, since there is usually more that can accidentally go wrong with our projects than can go accidentally right, which is the essence of Murphy's Law, shown in the skewed frequency distribution at Figure 1.6.

Figure 1.6 – Uncertainty distribution



Similarly, it's been my experience that risk events are more likely to compound to cause a disaster than they are to compensate or negate each other. So if we

expect random risk events to distribute themselves more or less evenly between good and bad luck, and impact each other for the betterment of our project, we're in for a sad surprise. It's possibly a manifestation of the Chaos Theory or the NIWA escape clause. The theory concerns the unpredictable interaction of events and NIWA are New Zealand's highly paid weather forecasters. In fact, our scientists have recently confessed that they cannot now keep up with extreme weather events linked to climate change. NIWA's attempts at three months-plus forecasting are no more exact than horse-racing tips. Forecasters blame their errors on La Nina of course.

Edward Murphy was an officer at Edwards Air Force Base, California, who in 1949 proclaimed that if a certain electrician was involved in the project, "Whatever can go wrong will." The story being that this electrician was inclined to wrong-wire equipment to cause fires, accidents and other problems. We have all experienced Murphy's Law. Has it ever started raining immediately after you washed the car? Also, we know if we don't have our driver licence with us that we have increased ten-fold the chances of being asked to produce it when for the first time in a decade we are stopped by the cops in a random roadside check. Well, as we know, projects are full of such happenings. There are several corollaries to Murphy's or Sod's Law that also seem very relevant to projects, and in particular:

- *Nothing is as easy as it looks.*
- *Everything takes longer.*
- *When we set out to do something, something else must be done first.*
- *Every solution breeds new problems.*
- *It's impossible to foolproof anything because fools are so ingenious.*
- *Nature always sides with the hidden flaw.*
- *Everything goes wrong at once.*
- *Parts that cannot be wrongly assembled will be.*
- *Variables won't and constants aren't.*

Given today's circumstances, Murphy might be regarded as an optimist (Murphy's wife's law!). There are of course several more such laws applicable to project management. For example, Parkinson's Law also seems relevant – "Work expands to fill the time available." In our efforts to mitigate Murphy's Law by adding

contingency time we might then invoke Parkinson's Law and unnecessarily prolong our project, or if we add more resources to complete the project on time, we might suffer Brooks' Law, which tells us that adding extra people to overcome schedule slippage will simply further slow down our project.

While Brooks was referring to knowledge workers and software development projects, I think his law has wider applicability. Interestingly, this slowing down, I've noticed, is often due to an excess or lack of items whose names all start with C – conflict, communication, coaching, congestion, cooperation, collaboration, coordination and control – the threat of which necessitates more management. Overheads then increase. We can see that project management isn't for the faint-hearted. They might be better to stay with business-as-usual where there's usually greater certainty and possibly greater promise of immediate job security.

So, why be a project manager with risk lurking behind every corner ready to devastate our creations? The answer is that the rewards are worth it, not only for our organisations and product users, but also for us project managers and team members who usually feel a great sense of accomplishment when a new product is deployed and we see people benefiting from its use often for years to come. Unlike the project itself, which has a finite life or should have, the deliverable that remains after project completion, is often a permanent or semi-permanent monument to our good risk management practices.

Our project leadership role is mainly one of risk management, whereby we pre-empt and remove obstacles to our project and team members' success, be they employees, contractors, consultants or suppliers, whenever they might join the team. We certainly don't hide risk, even from contractors. By enabling their success we help ensure project success and thus our own success.

There are no rewards without risk. Just ask our All Blacks, Lotto winners, Stephen Tindall, Michael Hill, Sam Morgan, John Key, Peter Jackson, Bob Jones, or any one of our many Kiwi achievers. A healthy regard for risk needs to be nurtured. Yet, some of our fine heroic and macho senior managers and inert project sponsors, readers of this book excused of course, can be complicit in keeping project disasters going. Instead of commending those project managers who suggest terminating overly risky projects, at best they view these project managers as inept and at

worst they replace them. I call these doomed endeavours "dead projects walking." We know exactly where they're going, but reputations, sunk costs, lack of courage and political considerations often dictate that these projects continue and thereby drain our resource pool and so deny more deserving project opportunities the chance of daylight. There can also be an adverse impact on business-as-usual if our organisation's limited and shared resources are allocated to inappropriate projects. If we have such a sponsor, we can be assured that disaster has not left to chance!

While we would like to pull the plug early on overly risky projects, it's sometimes only later in their life cycle that intolerable risk is identified. Nevertheless, if the project can't or shouldn't proceed or be satisfactorily recovered, it's time to admit failure, cut our losses, and to re-assign those scarce resources. At least with growing attention hopefully now given by our project sponsors to post-project benefit tracking, it seems more likely that future business cases will be grounded in some greater reality and enable us to cull out overly risky project propositions before they are assigned to some unfortunate project manager. One warning sign of pending frustration and futility is when business cases for different projects identify identical benefits.

The benefits of project risk management apply to all organisations, whether big or small, old or new, public or private. The benefits should be of particular relevance to senior managers who sanction projects, to clients (owners) and customers (users) who will more likely get what they want, when they want it, and for a cost they can afford, and to we project managers who want to bring our projects in within budget, on time, and to the required level of performance.

The cost of project risk management will vary with each project, but some 5-10 percent of the project's total cost is the suggested investment according to the Association for Project Management (APM). PRINCE2 suggests that 1-3 percent of the project budget might be spent on risk management prior to project execution, and 2-5 percent spent on risk control following implementation, which in total is 3-8 percent. Even accepting that PRINCE2 is primarily for government use, who are inclined to be risk-averse, these PRINCE2 percentages seem to be quite high for all except very risky projects.

No other project management authorities seem willing to commit to a figure or range, presumably because there are so many factors that influence a project's

riskiness. We recognise that different organisations have, and need to have, different levels of risk tolerance. For example, a risk-averse organisation may not last long in a highly competitive environment, whereas risk-taking may not be appreciated in the more cautious government environment.

The benefits of risk management are mostly achieved as risk is addressed in our initial feasibility study, when the client (owner) and sponsor sanction the project, during tendering and post-tendering, at intervals during project execution, especially when changes are contemplated or occur, and during the early life of the new product as risk management continues into the operational phase when most benefits are realised. Importantly, risk management must continue beyond the start of project implementation where for many projects it prematurely stops.

There are good reasons to employ project risk management. If it is applied systematically and consistently across our organisation and its application undergoes continual improvement, then some of the resultant benefits are likely to be:

- Increased understanding of the project, which in turn leads to the formulation of more realistic project plans, particularly in terms of their cost and time estimates.
- Increased understanding of the risks in the project and their possible impact, which can lead to the minimisation of risks for a party, or the allocation of risks to the party best able to handle them.
- An independent view of project risks, which can help justify decisions and enable more efficient and effective management of the risks.
- Knowledge about the risks in the project, which allows assessment of contingencies that reflect the risk, and also discourages the acceptance of unsound projects.
- Contribution to the build-up of statistical information of historical risks that will assist in better management of future projects.
- Facilitation of greater and more rational risk-taking, thus increasing the benefits that can be gained from sensible risk-taking.
- Assistance in the distinction between good luck and good management, and bad luck and bad management.

- Better project selection decisions, which increase the value or our organisation's project portfolio, while eliminating projects with unacceptable levels of risk.
- Provides project team members and other stakeholders a forum for expressing concerns and opportunities, and for challenging or defending assumptions, all of which harbour risk.
- Understanding of how project risks can lead to the use of more suitable types of contracts, which might range from the firm-fixed-price variety to reimbursement agreements, in order to properly assign risk.
- Risk assessment, or allowing for uncertainty in estimates, helps us set and justify contingency levels with a preferred level of risk, which enable us to establish realistic estimates of time and cost.
- Improve product and service delivery, provide greater competitive advantage, ensure less firefighting and rework, and fewer unwelcome surprises. This focuses our attention on doing things properly the first time, which means more efficient use our resources, and helps ensure that our projects cost less and take less time. As a consequence our morale, motivation, job satisfaction and even job security improve.
- Minimise management by crisis. When a significant risk event occurs, there is always a reactive response to it if the risk was not anticipated. Such reactions can be very disruptive, since time spent dealing with crises means less time available for normal management activities and prevention planning.
- Minimise surprises and problems. Identifying and planning for risks is the best way to avoid being surprised.
- Gain competitive advantage. Any well developed, documented, and implemented risk management process reduces the project schedule and cost impacts of risk events, thus improving the organisation's reputation and competitive advantage in the marketplace.
- Decreases project variances. One major problem in project management is maintaining project progress within often very tight variances from the baseline plan. Risk management is one of the principal ways of minimising these variances. If the risk is expected and an appropriate response is implemented in a timely manner, then the project's planned track is more likely to be maintained.

- Increases the probability of success and exploitation of opportunities. Keeping the project to its planned schedule and budget enhances the probability that the project can be completed successfully.
- Increases profitability. Poor risk planning invariably leads to rework, scheduling problems and cost overruns, whereas good risk planning eliminates many such problems and often contributes directly to the bottom line, and to the improved morale and motivation of those involved.
- Contributes to project success, which is the realisation of business case benefits, recognises uncertainty and provides realistic forecasts of possible outcomes, and produces better business outcomes through more informed and realistic decision-making.
- Positively influences creative thinking and innovation. Offers better control, less overhead, less time wasting, and greater focus on benefits. Helps management to understand what is happening with the project and the challenges the project needs to overcome.
- A frequently overlooked aspect of project management, effective risk management can often result in significant improvements to the ultimate success of our projects. Risk management can also have a positive impact on selecting projects, determining the scope of projects, and developing realistic schedules and cost estimates. It helps project stakeholders understand the nature of the project, involves team members in defining strengths and weaknesses, and helps to better integrate the other project management knowledge areas (PMBOK) and processes.
- Having a sound project risk management methodology in place can only help in our bidding for work, which also helps our contractors and sub-contractors become more successful too.

We can describe project risk management as the art and science of identifying, analysing, and responding to risk throughout the life of the project and this is undertaken in the best interests of meeting project objectives.

As mentioned earlier, good project risk management often goes unnoticed, unlike crisis management. With crisis management, there is an obvious danger to the success of the project. The crisis, in turn, receives the intense interest of the entire

project team and other stakeholders. Resolving a crisis has much greater visibility (sometimes accompanied by more significant rewards) than the attention we get from successful risk management.

An example of this practice was the Chilean gold mine collapse in 2010, described by several of the miners involved as an accident waiting to happen. Evidently, little forethought was given to accident prevention or contingency preparations. When the dust settled some hours after the cave in, the miners began to climb the emergency escape ladder in a ventilation shaft that should have lead them safely to the surface. But they only got a third of the way. The frugal mine owners had never bothered to finish the ladder to the top. Nevertheless, their rescue was a very effective project. Those rescued and their rescuers were proclaimed national heroes, with fame and publication royalties assured. The mine owners are out of business and probably somewhat wiser about the value of risk prevention. In contrast our local Pike River mining accident was fatal for all 29 miners for which a Royal Commission of Inquiry is to get underway on the 11 July 2011 – the same day that this book goes to the printers if all goes according to schedule for these projects. If feasible, the recovery of these 29 bodies will be a particularly risky project. The disaster is reminiscent of the 1967 Strongman Mine explosion that killed 19 men.

Of course project management was never intended to deal with disasters, which are more appropriately managed through business continuity and disaster-recovery plans. These are outside the scope of project risk management.

In contrast, when risk management is effective, it results in fewer problems, and for the few problems that do occur, it enables their more expeditious resolution. It may therefore be difficult for outside observers to tell whether risk management or luck was responsible for the smooth development of a new product, but project teams will always know that their projects worked out better because of good risk management.

An excellent example of a recent large and very high profile project where risk was superbly managed was the royal wedding of Prince William and Catherine Middleton. It would be fascinating to see the risk management plan that no doubt addressed risks such as inclement weather, traffic congestion, strike action,

crowd control, and perhaps some less obvious risks such as cold feet (either bride or groom), bachelor/bachelorette night excesses, fashion faux pas, football hooligans and other terrorists disrupting the wedding, wedding guests upstaging the wedding party, etc, etc. There were some issues such as Samantha Cameron forgot her hat, Princess Eugenie's unflattering frock, and her sister's Wagnerian antler hat, but otherwise an incident-free occasion and example of effective project risk management.

Critical factors, several of them being of the soft variety, not listed in any particular order, which if present, help ensure individual and organisational project risk management success, are:

- Shared understanding of the principles of risk management and the language involved.
- A simple and scalable project management and risk management process.
- Proven user-friendly tools and techniques to implement all elements of the risk management process.
- Timely contribution from experienced, trained and skilled staff.
- Clear project risk management objectives.
- Sufficient resources to implement the process, especially risk responses.
- Buy-in from all who have a stake in the process and the project.
- A risk-aware organisational culture that recognises the existence of uncertainty in projects and is determined to address it proactively.

Risk management should be part of our organisation's culture. It should also create value not just cost, be tailored to the unique needs of our projects and organisation, be dynamic and responsive to environmental change, and be continually improved. We recognise that risk management is an "add in" rather than an "add on" to our project management methodology. Also, risk management is applied to all projects – those with a range of durations from days to years and budgets ranging from a few hundred dollars to millions of dollars.

Today's business environment is fast-paced, competitive and uncertain. Products are proliferating and their life cycles are shortening. These characteristics emphasise the need for quick decision-making, yet often with incomplete

information, which may mean frequent changes in project requirements. In these circumstances project teams need to be agile and particularly risk aware.

Over recent years our approach to risk management has much improved. There is that famous photograph taken in 1932 of New York construction workers lunching on a skyscraper crossbeam hundreds of feet above street level. They have no safety boots, hard hats, or harnesses, and are seemingly oblivious to risk. Attitudes towards risk have certainly changed for the better. Imagine today if people recreated that skyscraper scene. The police would be called to talk the people down and their employer would be spending considerable time in court if not jail.

In summary, why do we manage project risk? We do so to avoid rework, improve the chances of project success, lower project costs, improve the project's priority, avoid chaos and firefighting, have fewer surprises, improve communications, reduce time needed, and avoid missing out work. If we don't get to grips with project risk management, our projects will quickly go pear-shaped. And to avoid projects in order to avoid risks, simply means missing out on opportunities. The answer is to manage the risk.

Good project risk management within our organisation is likely to have the following characteristics:

- Project risk management activities commence at the initiation of the project when risk management plans are developed, and then risk management continues throughout the entire project life cycle.
- Project risk management is not a discrete stand-alone process, but is closely integrated with all other project management functions. All project decisions will take risk into account.
- Implementation of project risk management is the responsibility of all project stakeholders, particularly project team members, and they participate actively in the process.

All projects face risk. This risk can be mitigated to some degree by taking the time to develop a project risk management process to help ensure threats have a limited effect on our project, while maximising opportunities. A skilled project manager understands the potential effects that risks can have on their projects,

and manages them accordingly. Yet, sometimes, even if management is receptive, we may have reasons for not addressing risk. For example, we are usually in competition with other projects for resources. In order to get these resources we need to complete our project – and thus keep our job – which means we cannot afford to admit potential problems. So we reason, like a wounded animal in the jungle, if we show our weakness, we are as good as dead. Yet, if our project is not competing for resources, we might ignore risk.

In the final analysis, most postmortems of project disasters conclude that their problems would have been avoided or much reduced if there had been an explicit early concern about identifying and resolving their risk. Frequently, these projects were swept along by a tide of unfounded optimistic, often by their enthusiastic sponsors particularly during the early phases of the project.

Experience has shown that risk management must be of critical concern to project managers since unmanaged or unmitigated risks are one of the primary causes of project failure, aside from simply foolish projects. If we anticipate problems and plan appropriate responses, we will not suffer those problems or be overly disrupted should those problems occur. If the unexpected then also happens, we will also be able to attend to this. Having mentioned that we must not be so pessimistic we cannot make progress, remember there is a balance between blithe optimism and morbid pessimism.

The purpose of this introductory chapter has been to set the scene, hopefully persuade you of the importance of project risk management, although you're probably already a believer, and provide you with some arguments in its support. And also whet your appetite for an explanation of the project risk management process, starting with discussion about risk management terminology and principles for effective project risk management.