3.5 Assessment of risk management approaches in other fields

The concepts of risk and uncertainty are explored in areas other than where business change is traditionally analysed. The purpose of this is to determine whether common threads exist and to pursue synergy arising from cross-functional pollination. These have been summarised as follows:

3.5.1 Financial

This section explores the risks and risk management techniques employed in the financial investment field. An organisation with surplus funds has the option of investing either in capital projects or the financial markets. Standard approaches used are NPV and IRR to assess the present value of cash flows and the related discount rate.

These methods do not however account for the riskiness of the investment. To facilitate understanding of the total investment risks of the options to invest in the financial markets or a capital project, two types of risks are defined, namely systematic and unsystematic risks. Ross et al [107] define:

- **Systematic risk** - a risk that influences a large number of assets. This is also termed as the market risk.
- **Unsystematic risk** - a risk that affects at most a small number of assets. This is also termed unique or asset specific risk.

Table 37 summarises these risks and the typical management techniques employed.

Table 37 - Financial Investment Risks and Techniques

Risk	Example	Techniques for Managing Risk
Systematic/market risk	Uncertainties about general economic conditions like GDP, interest rates, inflation, etc.	• Beta coefficient • CAPM • APT • OPT
Unsystematic/unique/ asset specific risks	Labour strike, unanticipated law suites, industrial accidents, etc.	• Portfolio management • Diversification

Dimson [108] evaluates the different approaches to assessing the cost of capital[1]. This is summarised in Table 38.

[1] He indicates that "the cost of capital is an opportunity cost. It is the return which could be obtained in the stock market from an investment that is similar in risk and maturity to the capital tied up in the project."

Table 38 - Evaluation of Approaches Determining the Cost of Capital

Approach	Method	Description/Evaluation
Financial economics	Capital asset pricing model (CAPM)	Standard approach to estimating the cost of capital.
	Arbitrage pricing theory (APT)	It is an extended version of CAPM with multiple sources of risk and return. Tends to be used by utilities in the USA.
	Option pricing theory (OPT)	Applied to valuing projects having capital projects with option-like characteristics. Tends to be used for valuing natural resource investments such as mines.
	Constant growth model	Its drawback is it assumes a dividend growth-rate that can be indefinitely sustained. It also ignores the riskiness of the investment.
Accounting based[1]	Dividend yield	It understates the cost of capital because it ignores the capital gains anticipated by the investor.
	P:E ratio/ earnings yield	It ignores expected growth in the company's earnings.
	Return on capital	A low accounting rate of return **does not** imply a low cost of capital.
	Return on marginal project	Project are ranked from most to least attractive and accept those of highest return. This is circular as projects cannot be ranked correctly unless the cost of capital is known.
	Funding cost	Using the interest rate payable by the company, the discount rate does not affect the full riskiness of the investment.
	Past return on company shares	This implies that poorly performing companies have the lowest cost of capital.

3.5.2 Banking

The banking sector deals with various forms of risk on a day to day basis from focused specialised areas, through to macro-economic level. These risks have been summarised in Table 39.

[1] Dimson views these approaches as flawed. The reasons for this are indicated in the description/evaluation column of the table.

Table 39 - Summary of Risk Management in Banking

Risk	Description	Techniques for Managing Risks
Credit risk	The risk that loans cannot be repaid by a debtor on time or otherwise.	• Actuarial principle of risk diversification [109] - portfolio of population groups, geographic areas, products, purposes and debt smoothing (balance between short and long-term). • Prudent lending [110] to ensure that losses < (total loan charges of whole loan portfolio - loan costs - margin). • In the event of risks realising, options include [109]: conversion of debt to equity, agreeing on a period where only interest is settled, lowering the interest rate or lengthening the loan payback period.
Interest rate risk	Balancing the book between long-term fixed lending rates and short-term financing (borrowing) rates, i.e. different periods of maturity between assets and liabilities.	• Balance borrowing short and lending long against short-term rates [110]. • Align maturities between assets and liabilities [111]. • Methods of analysis include [111]: maturity structure, balance sheet projection, gap exposure, net interest income projection, interest sensitivity. • Strategies for managing risk include [111]: engaging a new pricing strategy, adjusting mix of assets and liabilities (volume strategy), selling the risk to a party willing to absorb this (hedging strategy).
Liquidity risk	Abnormal demands for cash, transfers or term loans and not being able to redeem these commitments on demand.	• Hold excess statutory liquid assets [110]. • Borrow through money market to meet cash drains [112]. • Cash flow management [113]. • Short-term maturity structure of loans [112]. • Turn long-term assets involving low credit risk (e.g. 20 year government stock) into cash [112]. • Turn certain short-term "liquid" assets into cash [112]. • Manage the portfolio (mix and term structure) of liabilities and assets [112]. • Decentralised decision-making on the asset side and centralised monetary and control on the liability side [112].
Currency risk	The gap between forex receivables and payables and interest payable on	• Forecasting. • Manage risks in foreign markets by creating a mismatch between its spot (cash) and forward

Risk	Description	Techniques for Managing Risks
	these. Currency risk is constituent of transactional, economic and translation risks.[1]	books by means of (1) natural business, (2) doing forward swaps on the market or (3) interest rate arbitrage [114]. • Hedging currency risk exposure [114].
Investment risk	Impact of changes in interest rates, shares and property value on marketable securities and fixed assets other than by default or late payment.	• Expected rise [110] - shorten maturity structure of the fixed-interest securities portfolio or sell related shares. Expected fall - selected sales of such assets. • Structure on optimum assets mix (portfolio) [115]. • Hedging [115].
Capital risk	The risk of a bank's own capital resources being impacted on by external influences. This risk is common to other organisations.	• Maintain adequate capital resources to protect depositors against operating losses and investment losses [110]. • Scenario planning [116]. • Optimisation of capital structure using linear programming techniques [116].

[1] Note: These are the same risks typically experienced by any other organisation dealing with forex, only degrees differ.

While the table summarises management approaches that can be used to deal with each of the risks, it is important to note that this cannot be done in isolation. For example, in order to increase profits a bank may borrow short-term and lend these funds long term [109]. Interest rate exposure will be improved but at the cost of decreased bank liquidity. This is an important principle that needs to be taken into account when managing the risks related to business transformation.

3.5.3 Technological

Technology more than ever before is becoming a key resource that can significantly impact on a company's competitive advantage, and accordingly affect its competitive environment. As many academics and practitioners have pointed out, the rewards are high, but so can the risks be [10,55,117,118, etc.]. The concept of the management of technology (MOT) has progressed considerably since the 1950's and 60's. Many organisations nowadays link their R&D initiatives into their business strategy. Various companies have yet to move to 4th generation R&D [119], where competitive advantage is driven through via advanced technology and innovation acquisition and deployment actions.

Schon [120,p12] relates the difference between uncertainty and risk in respect of MOT as follows:

"*Men involved in technical innovation in a corporation confront a situation in which the need for action is clear but the action itself is not. So long as this situation exists, the corporation cannot function effectively, because it is not designed for uncertainty in a situation in which there are no clear objectives to reach, no measures of accomplishments and no proper concept of control. A corporation cannot operate in uncertainty, but it is beautifully equipped to handle risk. It is precisely an organisation designed to uncover, analyse, evaluate and operate on risks.*"

While the assertion that the corporation is beautifully equipped to handle risks poses questions, it nevertheless indicates that while it cannot reduce all uncertainties, it can attempt to manage risks. Roussel et al [118] suggest the use of scenarios rather than explicit forecasts of the future. They propose the relationship between risk and reward as shown in Figure 53.

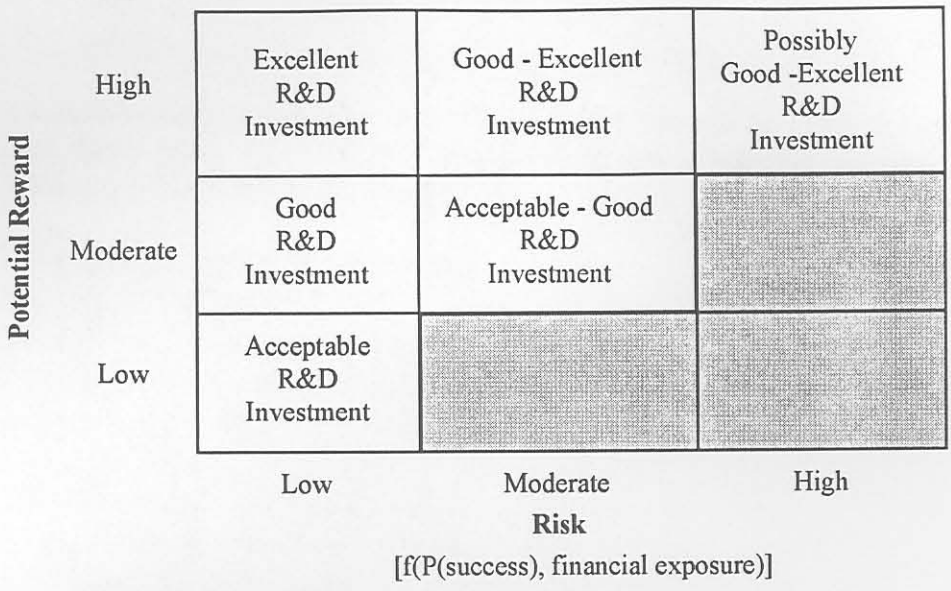

Figure 53 - The Desired Relationship between Risk and Reward in R&D Investments

They add that there are no rigorous definitions of "low", "moderate" or "high" risk or potential reward. Each is influenced by company culture, strategies, its operating industries and competitive conditions.

Most literature describes the three types of R&D or innovation that can be undertaken, namely incremental, radical or fundamental. These three types also relate directly to the probability of success and hence the risk-reward relationship. Roussel et al [118, pp54-57] describe the characteristics of these types in Table 40.

Table 40 - Characteristics of the Three Types of R&D

Type	Description	P(technical success)	Time to Completion	Competitive Potential	Durability of Competitive Advantage
Incremental	Clever exploitation of existing knowledge in new ways. Characterised by low risk and modest reward.	Very high, typically 40 to 80%.	Short, typically 6 to 24 months.	Modest but necessary.	Short, can be imitated by competitors.
Radical	Creation of knowledge new to the company, possibly the world to achieve a specific objective. Characterised by higher risk and higher reward.	In early days modest, typically 20 to 40%.	Mid-term, typically 2 to 7 years.	Large	Long, often protected by patents.
Fundamental	Creation of knowledge probably new to the world to deepen the understanding of a scientific/engineering area. Characterised by high risk and uncertain application to business needs.	In early stages, difficult to assess, depends on R&D concept.	Long, typically 4 to 10 years or more.	Large	Long, often protected by patents.

Literature and practice offer various techniques that can be employed to manage these risks that R&D pose. The following list, although not exhaustive provides the more common techniques that assist in this regard:

- Scenario planning [118,121,122].
- Trend extrapolation [121].
- Precursor trends - curve matching [121,122].
- Technological substitution [121].
- Delphi [121,122].
- Relevance trees [121,122].
- Technological monitoring [121].
- Cross-impact analysis [121,122].
- Analogy methods [122].
- Morphological research [122].
- Catastrophe theory [122].
- Systems dynamics [122].

As described previously, analysis is one component of management. The following describes approaches aimed at the remainder of the components of managing the risks in business change due to technological change or investment therein.

- Managing the R&D portfolio [117, 118].
- Establishing a strong business focus [123].

- Encouraging organisational adaptability [123].
- Encouraging organisational cohesion[1] [118, 123].
- Engineering and entrepreneurial culture[2] [118, 123].
- Nurturing a high sense of integrity [118, 123].
- Hands on top management [123].
- A well planned, realistic course of development [118].
- Continual re-evaluation of the projects, their priorities and requirements [118].
- Creating a sense of importance and urgency [118].
- Willingness to terminate projects [118].

Roussel et al [118, pp151-161] describe 7 practices that align the objectives of MOT and the practices that must be instituted to ensure success. These incorporate many of the concepts described above. This relationship is shown in Figure 54.

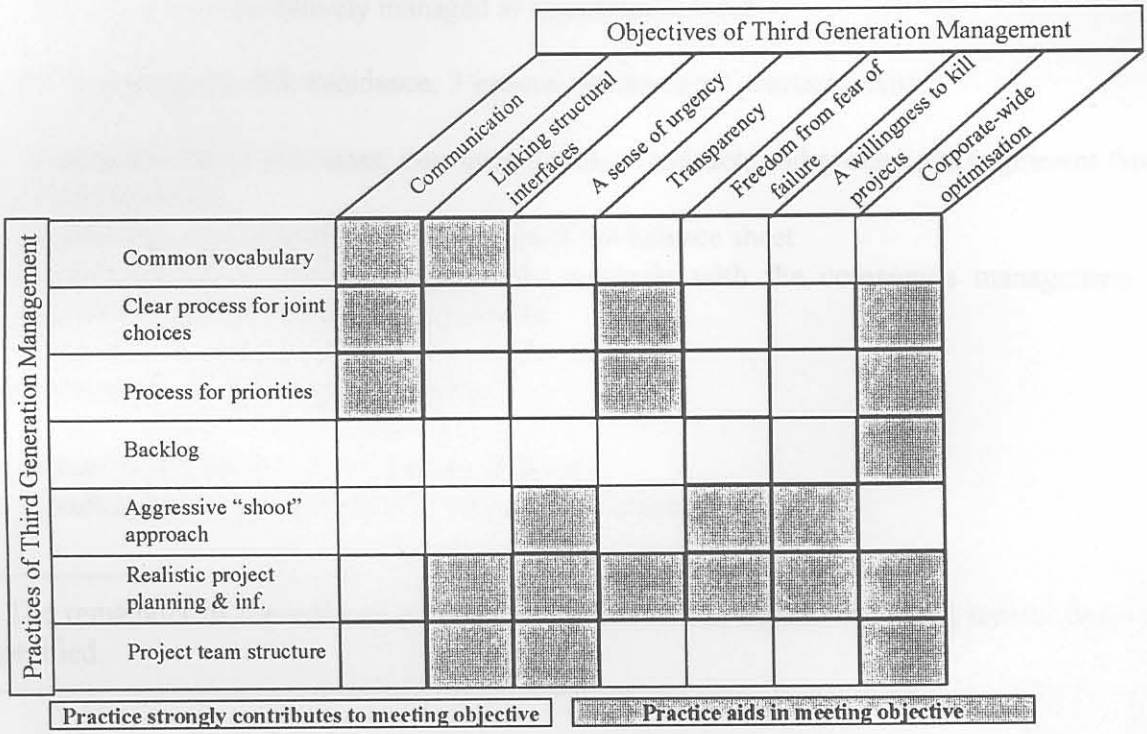

Figure 54 - Roussel et al's Linkage between Objectives and Practice in R&D Management

3.5.4 Insurance

The insurance industry was possibly the first to "embrace" risks and channel this into business opportunity. Accordingly, this industry has a range of risks unique to it, but also has unique ways of dealing with this.

[1] This is achieved via good communication, job rotation, integration of roles and encouragement of long term employment.

[2] This includes entrepreneurial characteristics, variety of funding channels, tolerance of failure and the opportunity to pursue outside projects.

The role of insurers in industry is described as follows [124][1]:

"market participants seek the services of insurers because of their ability to provide actuarial risk pooling through their major product lines of life, property/casualty and health insurance, pension products, annuities and other financial instruments. At the same time, they are major providers of funds to the capital market - particularly to the fixed income sectors. In performing these roles they generally act as a principle in the transaction. As such, they use their own balance sheet to facilitate the transactions and absorb the risks associated with them"

It is in this context that the insurance industry needs to manage its risks.

The rationale for risk aversion in this industry can be categorised as follows:

- Managerial self interest.
- Non-linearity of taxes.
- Cost of financial distress.
- Existence of capital market imperfections.

According to Babbel and Santomero, the insurance industry will eliminate or mitigate risk by means of proper business practice or transfer this to a third party by means of a combination of reinsurance, pricing or product design. It is only the risks which cannot be dealt with in this way that should be left to the company to manage for its own account.

"It should accept only those risks that are uniquely a part of the insurer's array of services."

Oldfield and Santomero [125] indicate that there are 3 general categories of risk facing all financial institutions (including insurers):

- Risks that can be eliminated or avoided by means of standard business practice.
- Risks that can be transferred to other parties.
- Risks that must be actively managed at organisation level.

In the first category, risk avoidance, 3 general management practices exist:

- Standardisation of processes, insurance policies, contracts and procedures to prevent faults or inefficiencies.
- Establishment of portfolios on both sides of the balance sheet.
- Implementation of incentive compatible contracts with the company's management to require that personnel is held accountable.

Techniques of transferring risk include:

- Actuarial risk can be transferred to reinsurers.
- Catastrophe risk can be offset by catastrophe futures or bonds.

[1] The remainder of the sub-section is based on Babbel and Santomero [124] unless otherwise specified.

- Interest rate risk can be hedged or transferred through interest rate products like swaps, caps, floors, futures or other derivative products.
- Insurance policies can be altered to affect a change in duration and convexity.
- Equity market risk can be reduced with an appropriate futures position in equity.
- Financial risks can be transferred to the purchaser or transferred by means of defined contribution pension plans or variable universal life policies.
- The insurer can buy or sell financial claims and reinsurance to diversify or concentrate risk that results from servicing its client base.

There are two classes of risk that need to be managed at organisational level, i.e. those risks that cannot be eliminated, avoided or transferred, namely:

- Actuarial exposures where the nature of the embedded risk may be difficult to transfer to another party.
- Risks that are central to the raison d'être of the business, i.e. those areas where competitive advantage is derived.

In order to analyse risk, define procedures to manage these risks, limit exposures to acceptable levels and encourage decision-makers to align action with corporate intent regarding two classes of risk, the following practices are recommended [124, pp7-9]:

- Standards and reports.
- Underwriting authority and limits.
- Investment guidelines or strategies.
- Incentive contracts and compensation.

From the range of risk management principles and techniques in the insurance environment, the following would appear to be useful in the business change environment:

- **Principles**:
  - Only manage risks at organisational level that cannot be eliminated, avoided or transferred to another party.
  - Become excellent in managing those risks that are coupled to the raison d'être of the business.

- **Methods**:
  - Insurance
  - Hedging
  - Portfolios
  - Sound business practice pertaining specifically to:
    - Clear standards and appropriate reports.
    - Clear lines of accountability and responsibility with limits well defined.
    - Investment guidelines, objectives, strategies and philosophies in place.
    - Performance contracting coupled to risk management.

3.5.5 Environmental

Environmental issues are becoming more of a reality with pressure being applied internationally as well as in South Africa. The Kyoto Protocol for example has ensured that all the world's industrialised nations have agreed to firm targets for reducing six different greenhouse gasses[1] [126].

Mines have to develop strict rehabilitation plans, chemical producers are required to manage their effluent in a more strict manner, setting up plants requires more control. Examples of the latter include the moving of the Saldanha Steel site and the termination of the St Lucia mining project. The threat of these strict external drivers can however be turned into opportunity. Changes in technology and or product to become "environmentally friendly" can be a significant source of competitive advantage (until the competition responds accordingly). Examples of this include:

- Wisaforest Oy Ab (Finland) transformed its process to totally chlorine free paper and pulp processing.
- Sappi (South Africa) have employed ozone technology.

There are however significant risks associated with the territory. In the environmental field, there are two primary areas where risks need to be managed:

- On the operational level where the risks of impacting on the environment from day to day activities must be managed, e.g. prevention and management of effluent leakages.
- On the strategic level where decisions regarding the longer term operations like the investment in new technology are made.

The former tends to be dictated by the MOSH act in South Africa. Other tools for managing this include HAZOP/HAZAN processes, TQM, public health assessments and other environmental auditing and management systems (e.g. ISO14000). The latter does however provide more relevance to this study.

Table 41 provides a summary of the types of strategic risks an organisation may deal with [127][2].

[1] The treaty requires that:
- Developed countries cut emissions of CO_2 and five other gases by an average of 5.2% by 2012.
- Cuts in developing countries are voluntary.
- Emissions trading would permit countries that beat their targets to sell excess reductions to those that fall short.
- Forested countries will get a break on their quotas because of CO_2 absorption.
- Penalties for violating countries are still to be determined.

[2] This has been summarised from work done by Moilanen et al [127].

Table 41 - Summary of Risk Management in the Environmental Field

Risk	Description	Techniques for Managing risks
Research and Development risks	Three general types of risks incurred are technical project progress or target oriented risks.	• Lower the perception of risk. • Have a good understanding of what the costs are and what the impact is on changing scenarios. • Life cycle assessments.
Product design risks	This arises from changes in consumer requirements and the regulatory environment.	• Close co-operation with customers in product design. • Close monitoring of the regulatory environment.
Production process risks	Three general risks include technical, legislative changes and liabilities.	• Life cycle assessments. • Insuring environmental liabilities. • HAZAN/HAZOP studies. • Provision of financial buffers for eventualities.
Marketing and marketability of products	The risks include [128]: • demands for environmentally friendly products do not materialise as expected, • consumer is not ready for the product, • pressure on cost due to environmental investments, • environmental performance is not adequate on its own for the product's competitiveness, • internal opposition for new products or processes (RTC), • regulatory environment is unclear and distribution channels are not interested in the product.	• Close monitoring of the regulatory environment. • Thorough market research (e.g. conjoint analysis). • Hedging. • Phasing in of production. • Insuring. • Communication.
Corporate image risk	Risks include negative perceptions and false interpretation.	• Measure corporate image and determine the effects that various actions have on this. • Measure the financial implication of the image and treat accordingly. • Use of eco-balances (document describing how the organisation is interacting with the environment).

Moilanen et al [127] proposes the expected monetary value (EMV) technique to be used in the appraisal of the investment projects as it makes provision for risk inclusion as each parameter is assigned a probability.

A second key assessment technique supported by the author is the use of life cycle analysis (LCA) for evaluating the impact of the product on the environment. The author further

provides a methodology for the financial evaluation of the environmental investments which incorporates the above-mentioned concepts. This is shown in Figure 55.

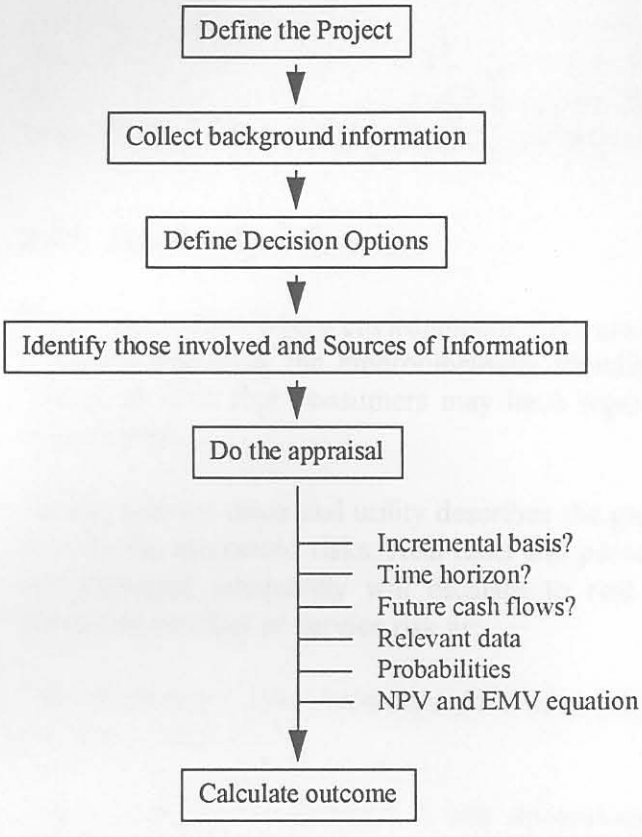

Figure 55 - Moilanen et als' Environmental Investment Evaluation Methodology

3.5.6 Business investment risks

Businesses invariably have to make an investment of some form with the expectation that a satisfactory return will result. As the investment consumes equity[1], concern arises whether the desired level of returns will indeed be realised. One way of addressing this concern is to identify the relevant risks and manage these accordingly.

The return on an investment can be viewed having various dimensions, namely:

- Size of the return (future value).
- Size of return (current value).
- Period (how long before the return is realised).
- Frequency of returns.
- Format of returns (currency, assets, etc.).
- Effort involved in achieving returns.
- Likelihood of returns.

[1] Equity has traditionally been equated with capital. There is however a growing desire in the business community to include other aspects such as intellectual equity. This does however, complicate the accounting practice behind this.

The last mentioned dimension deals with the uncertainty and riskiness of the investment. All these dimensions interact and have an effect on the "desirability profile" of the investment. Typical financial instruments include net present value (NPV), internal rate of return (IRR), return on investment (ROI) and return on net assets (RONA). Risk however affects the attainment of these, providing another criterion to take into consideration. Expected monetary value (EMV) does however make provision for the inclusion of risk in the calculation.

A means of dealing with risk is being able to select one project amongst many. Utility theory [129] provides a theoretical framework for comparing various uncertain outcomes. Hull [130] however points out that different people have different utilities for different outcomes in a certain situation and can be analogous to subjective probabilities. Every person has different levels of risk aversion depending on the different impacting factors.

Another way of managing risks is by not keeping the eggs in one basket. This then provides a probability distribution where the mean and variance are favourable to the risk profile of the investor. On "average" the risks will be minimised or accounted for by the weighted favourable returns. Hull suggests that two areas of conflict can exist here however. Having the security base of the portfolio, the investor may consider an investment a low risk, while conversely the manager whose job is on the line if the investment fails may regard the risk huge and may take a meaningful set of proactive steps.

3.5.7 Perceived product risks

Under the section where environmental risks are described, product risk features as one of the concerns regarding the environmentally friendliness of products. This section looks at the perceived risks that consumers may have regarding the product or service offerings of an organisation.

The section on value and utility describes the gap between real and perceived value. This ties in with the associated risks. Real risks and perceived risks. Like real risks, perceived risks, if not managed adequately will escalate to real risks. Schiffman and Kanuk [131] define perceived product or service risk as:

"the uncertainty that consumers face when they cannot foresee the consequences of their purchase decisions"

The authors further describe 6 risk dimensions that a consumer can perceive. These are summarised in Table 42.

Table 42 - Risks Consumers Face

Risk	Description	Type of Uncertainty
Functional risk	The product will not perform as expected.	• Will it do as it is supposed to do? • Will it last? • Will it work as well as or better than competitive products?
Physical risk	Safety and health aspects.	• Is it safe to use? • Does it pose any physical threat to others? • Does it pose any environmental threats?
Financial risk	Risk that the value exchange (money for product) is not equitable.	• Is it the best use of limited funds? • Is it worth the money it costs? • Is it the best price?
Social risk	Poor product choice could result in social embarrassment.	• Will the immediate environment approve? • Will it please those whose opinions are important? • Is it similar to products used by groups of similar identity?
Psychological risk	The risk that a poor choice will bruise the consumer's ego.	• It is deserved? • It is impressive? • Does using it feel good?
Time risk	Time spent on product search if product does not perform as expected.	• Is return or exchange required? • Will the selection process be required again?

The authors further categorise risk management strategies most often used by consumers in product/service selection which address all or most of the risks. These are:

- Information seeking.
- Brand loyalty.
- Major brand image.
- Vendor image.
- Most expensive model.
- Reassurances, e.g. guarantees, warrantees, government approvals, etc.

3.5.8 Engineering projects

Frigenti and Kitching [62, p34] provide for general approaches in treating risk. This is illustrated in Table 43.

Table 43 - Approaches to Treating Risk in Engineering Projects

Approach to treatment	Avoidance	Abatement	Retention	Transfer
Description	The identified risk can be avoided	The combination of loss prevention and reduction to lower the likelihood of occurrence and diminish the severity of loss.	The risks are not changed by external influence even though they have been identified. Status quo strategy.	The risk is shifted from one party or element to another via structured means like contracting or insuring.

3.5.9 Systems reliability engineering

The concept of systems reliability engineering is a field of study used increasingly by engineers over the last 30 to 40 years to effectively design systems. The systems originally envisaged, involved electrical and mechanical systems where discrete components of a system could cause the whole system to fail. It allowed design to move to the position where failure is a given, and then design a system where the configuration of components allowed for a favourable or at least planned failure condition.

This approach has various benefits, including:

- A goal of desired functionality is established up-front.
- The components of the system are analysed using the principles of general systems theory (described earlier).
- Failures and their frequencies are understood.
- Contingencies are established to support the evaluation of these failures.
- A resulting expected economic impact can be evaluated.
- The desired cost-effectiveness of the system can be achieved by sensitivity analysis supported by the mathematical models.

These attributes point towards an intuitive relationship between reliability and risk. Frankel [132, p11] describes the relationship between reliability and risk of failure as complementary concepts. He states that:

"the reliability of a system is the probability that the system will not fail during a specified time period under given operating conditions, while risk of failure is the probability that the system will fail during that period and operating conditions ... Most systems interact with and are affected by other systems which may induce conditions or factors which increase the risk of or actually cause failure of the system."

In systems reliability engineering context, the probability of success can be equated with the reliability of the system under consideration. The probability of failure is

Equation 4

$$P(failure) = hazard\ rate = 1 - P(success) = risk$$

Two major methods are employed in reliability modelling of complex systems[133], namely[1]:

- Systems reliability evaluation using probability distributions.
- Markovian modelling.

The former technique (probability distribution) although applicable to repairable and non-repairable systems [133, p206], in the case of repairable systems the repair process must be instantaneous or negligible when compared with the operating time. This technique is therefore invalidated if the assumption cannot be held true. The Markovian approach addresses this shortcoming.

3.6 Appropriate Risk Management Techniques

Frigenti and Kitching [62, p32] provide the cyclical model of risk management shown in Figure 56.

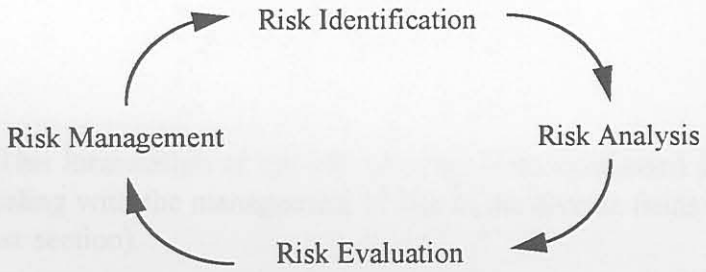

Figure 56 - Frigenti and Kitching's Risk Management Cycle

There are two types of components in this model. Firstly understanding what these risks are and secondly dealing with these risks during the execution of the relevant actions. Boehm [134] provides a risk management model similar to this. His framework, constituent of two phases, firstly a risk assessment which is followed by risk control in execution. As discussed earlier in the text, Charette views the process a little differently (see Figure 20). He raises analysis out of the management process which pertains to:

- Risk identification.
- Risk estimation.

[1] Techniques employed in simpler systems include [133] (1) conditional probability, (2) cut set method, (3) tie set method, (4) connection matrix techniques, (5) event trees, (6) fault trees and (7) multi-failure modes.

- Risk evaluation.

while he ascribes management to that set of implementation orientated actions that pertain to:

- Planning.
- Resourcing.
- Controlling.
- Monitoring.

Schwartz [135] experienced with Shell that assessing a solution and developing scenarios alone was not enough to be successful. An active effort has to be unleashed to change the current paradigms in order for firstly the realisation to take place and secondly for the appropriate contingencies to be set in place.

The model of risk management purported by Charette earlier requires a more encompassing approach. The four traditional management components are planning, organising, leading and controlling. Figure 57 illustrates the typical division of management time to these dimensions through the traditional business improvement initiative life cycle[1].

[1] This formulation of the life cycle has been condensed from the assessment of the literature dealing with the management of risk in the diverse fields of study (evaluated in the preceding text section).

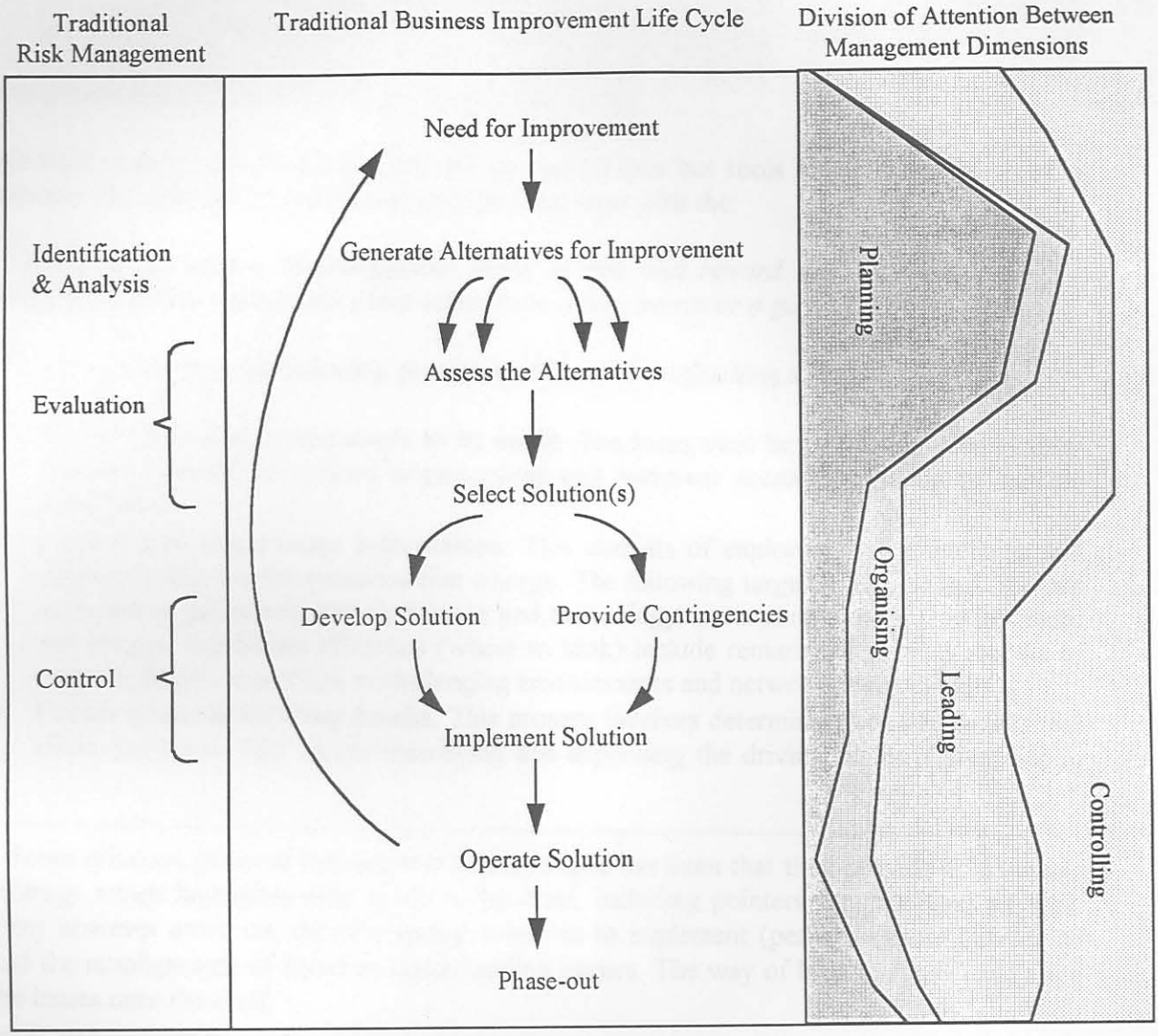

Figure 57 - Traditional Business Improvement Life Cycle

From Figure 57, risk management is traditionally viewed important in the phases after the identification of the need for improvement or service, until and including implementation. It may be argued that reasons for this are:

- Risk management has generally been employed in fields where concern has primarily been on providing a solution with the least pain.[1]
- The environment has generally been forgiving enough on post-implementation effects.[2]
- The functional view on responsibilities and delivery allowed for the "passing of the buck" types of situation to occur.[1]

[1] In the case of a construction project the focus is on delivering a solution with the least pain and most profit. It is then handed over. Other than the safety implications, the contractor is not concerned with the remainder of the life cycle risks (e.g. environmental impact, maintenance, removal, etc.).

[2] For example, until recently mine rehabilitation never entered into the up-front investment assessments.

With the competitive environment and other additional external drivers (e.g. the green movement) today, risks need to be managed throughout the complete life cycle, including operation and phase-out. This need was echoed in the market research.

(a) Scenarios

One of the only certain facts of life is that the future is uncertain. Sometimes this is dealt with by pre-concluding in absolute terms that a system will or cannot reside in a certain state. How many times have brave assumptions been dismissed by reality proving the contrary. When this "impossible" state does occur, then the persons involved are caught with plans lacking and failure looming. It is therefore prudent to speculate on the possible formats of the future, validate the assumptions and plan for eventualities. A very useful tool in achieving this is scenario planning.

Schwartz [135, pp4-7] defines scenarios as:

"a tool for ordering one's perceptions about alternative future environments in which one's decisions might be played out. Alternatively: a set of organised ways for us to dream effectively about our own future. Concretely they resemble a set of stories, either written out or often spoken. However, these stories are built around carefully constructed "plots" that make the significant elements of the world scene stand out boldly. This approach is more a disciplined way of thinking than a formal methodology."

He further advocates that scenarios are not predictions but tools to facilitate the learning process. He indicates that scenarios provide a manager with the:

"ability to act with a knowledgeable sense of risk and reward that separates both the business executive and the wise individual from a bureaucrat or a gambler."

The author provides the following process guidelines to establishing scenarios:

- **Isolate the decision that needs to be made**. The focus must be refined between broader scenarios general to various organisations and narrower scenarios relating to specific situations.
- **Gather and disseminate information**. This consists of exploring and researching and constantly refining the questions that emerge. The following targets (what to look for) are provided as guidelines, namely science and technology, perception shaping events, music and fringes. Guidelines of tactics (where to look) include remarkable people, sources of surprise, filters, immersion in challenging environments and networked sensibilities.
- **Create scenario building blocks**. This process involves determining the key factors that affect decisions. This entails identifying and explaining the driving forces. Categories to

[1] Some criticism of some management consultancies has been that they provide an excellent strategy which highlights what needs to be done, including pointers for managing pit falls. They however move on, the next group comes in to implement (perhaps other consultants) and the misalignment of focus or understanding occurs. The way of least resistance is to put the issues onto the shelf.

initiate this include society, technology, economics, politics and the environment. Next, the "predetermined elements" and the critical uncertainties" are established.

- **Determine the plots**. The authors described the following common types of plots which may be constructed in scenario development. These include winners and losers, challenge and response, evolution, revolution, cycles, infinite possibility, the lone ranger and my generation. The first three are most used. Various plots will intersect in a scenario.
- **Rehearse the future**. When scenarios are devised, their realisation is unclear, but as the future starts unfolding, clues will be made available regarding direction. Having prepared for all will allow for quick action when called upon.

A step-by step guide to developing scenarios is provided in appendix F.

This process is iterative. In general, three types of scenarios unfold, namely:

- More of the same fundamentals, but better.
- Worse (decay and depression).
- Different, but better (fundamentals change.

Scenario planning, while providing a tool for understanding the drivers shaping the future, and hence the likelihood of execution is poised at the strategic level and should be included into a framework for dealing with risks and uncertainty at this level. With the emphasis on enacting the full management cycle, scenarios must be used and managed in a way where behaviour is influenced. It serves not merely for information purposes.

(b) System dynamics

The field of system dynamics evolved from the application of feedback control principles to socio-economic systems [136]. In essence the approach recasts feedback control theory in a numerical analysis framework [137]. In system dynamics there is a heavy reliance on diagramming. Conventions vary (e.g. compare [137] versus [138]), but the popular approaches include the causal loop and stock and flow diagrams [138]. These are described as follows:

- The causal loop diagram illustrates causality between variables.
- Stock and flow diagrams contain more information on structure than causal loop diagrams and are a common step towards building a simulation model because they help define types of variables that are important in inducing behaviour. Stocks are fundamental to generating behaviour in a system, while flows cause stocks to change.

An example of a corporate growth model is shown in Figure 58.

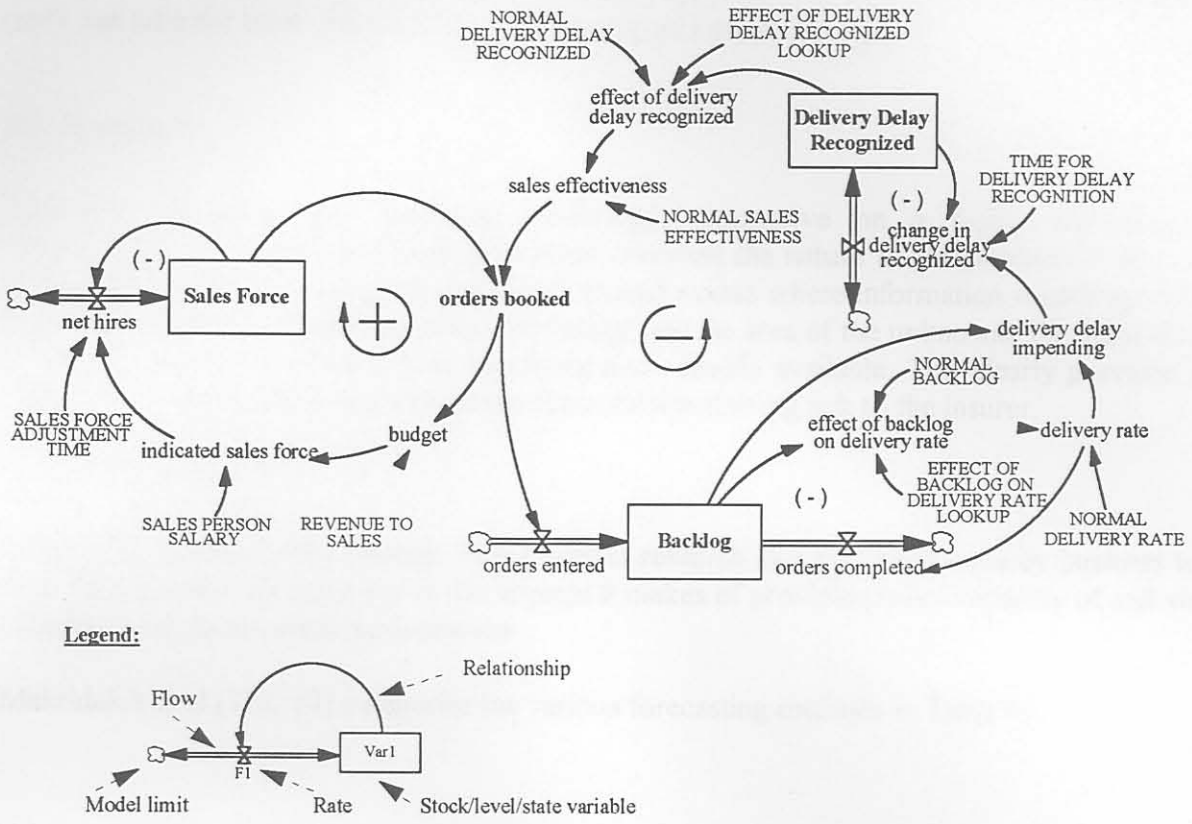

Figure 58 - Corporate Growth Model

Over the years with the extensive level of modelling been undertaken, it has become apparent that certain sets of relationships recur. The most common structures or archetypes are [139]:

- Accidental adversaries.
- Balancing loop.
- Drifting goals.
- Escalation.
- Fixes that fail.
- Growth and underinvestment.
- Limits to success.
- Re-inforcing loop.
- Shifting the burden.
- Success to the successful.
- Tragedy of the commons.

The archetypes are described in detail by the source [139].

Ventana Systems summarise the benefits of systems dynamics as follows [138, p vii]:

"System dynamics has the major benefit of making explicit all assumptions about how things are connected. In a business setting, for example, we know that morale can have a significant influence on productivity. Neither morale nor its influence on productivity can be directly measured, but leaving it out is certainly wrong and it is, therefore, often included in

models. A methodology for inclusion of these soft variables has been developed in system dynamics. This methodology can be applied to typically non-quantitative fields such as history and literature to explicate and investigate the nature of relationships".

(c) Hedging

Hedging is a technique which emerged in the financial areas of endeavour as core to many risk management actions. A financial definition of hedging is:

"The process of protecting the value of an investment from the risk of loss in case of price fluctuations. Hedging is generally accomplished by the protection of one transaction by means of another. A long position in an underlying instrument can be hedged or protected with an offsetting short or short equivalent position in a related underlying instrument"[1]

One of the most popular uses is the provision of forward cover in the face of exchange rate dips or where bond rates are expected to decline.

While it is possible that these may have a limited bearing on business change risk, it is possible to take the hedging concept and apply it to the benefit of business change risk in general.

Hedging in this case then is an instrument whereby the negative impact of a risk occurring is limited by virtue of the transfer of risk ownership beyond a ceiling to a third party. The third party can take the form of an action or object such as a person or market.

(d) Insurance

Insurance companies are becoming increasingly innovative on a highly competitive environment. One of the key innovative areas concerns the nature of the product. Where in the past, products were generally orientated around events where information regarding their behaviour has been well defined, they are moving into the area of the unknown. The insurance of some business initiatives is now becoming more readily available. This clearly provides a management intervention option with the focus on transferring risk to the insurer.

(e) Forecasting

Forecasting emerged very strongly in the market research as a technique used by business to help manage risks. Its value lies in the attempt it makes of providing more certainty of and via information in an uncertain environment.

Makridakis et al [122, p8] categorise the various forecasting methods in Table 44.

[1] The definition was provided by NationsBank.

Table 44 - Categories of Forecasting Methods and Examples of their Application[1]

Type of forecasting situation	Type of Information Available: Sufficient quantitative information is available		Little or no quantitative information is available, but sufficient qualitative knowledge exists		Little or no information is available
	Time-series methods	Explanatory or causal methods	Explanatory methods	Normative methods	
Forecasting continuation of patterns or relationships	Predicting the continuation of growth in sales or GDP	Understanding how prices and advertising affects sales	Predicting the speed on transportation around 2020	Predicting how cars will look in 2005	Predicting the effects of interplanetary travel; colonisation of the earth by aliens;
Forecasting changes - or when changes will occur - in existing patterns or relationships	Predicting the next recession or how serious it will be	Understanding how the effects of price controls, or the banning or advertising on TV will affect sales	Forecasting how a large in crease in the oil price will affect the consumption of oil	Having predicted the oil embargo which followed the Arab-Israeli war	discovery of new cheap, harmless energy that has no pollution impact

The role that forecasting plays in the risk management context is similar to benchmarking. Their purpose is to provide insight into a practice, event or object. It is this insight which guides the analysis in all the processes including identification, estimation and evaluation.

(f) Portfolios

Portfolios are simply an approach to minimise the effect of risk by not "keeping all the eggs in one basket". The benefit arises from diversification and the application of the Law of Large numbers and the Central Limit Theorem [124] which reduces the effects on any one loss experience.

For a portfolio, the expected return is [107][2]:

Equation 5

$$E(R_p) = \prod_{i=1}^{n} (x_i \times E(R_i))$$

Where:

x_i is the percentage of money in investment i.[3]
$E(R_i)$ is the expected return of investment i.

[1] Some of the information has been modified to make the examples valid in today's context.
[2] This has been simplified from the source.
[3] x_i is also the portfolio weight of the individual investment.

$E(R_p)$ is the expected return of the portfolio.

It is worth noting that only unsystematic risk can be diversified and not systematic risk [107, p345]. The reason lies in the relative sensitivity of the unsystematic risk as opposed to the relative insensitivity of systematic risk.

(g) Management of unwritten rules

As described previously, much literature exists on change management. Of the total amount, a significant portion pertains to the human related issues. It could be argued that this is reasonable considering that business change results from and exists for people. The range of change interventions that are available are classified in Table 2 and appendix A.

In order to determine which type of change initiative would be appropriate, the type of business change must be determined and then matched against Table 2. This must then be correlated to the associated risks. Once this is known, then the appropriate intervention should be selected.

There is one change method that should be considered, regardless of the type of business change under consideration, namely the "unwritten rules". This is described below.

One of the popular themes over the last decade has been performance measurement and hence management. The concept has been to set the strategy - vision, mission and so forth and then to set measures into place to determine how business is performing against the strategic baseline. Concepts like critical success factors (CSFs), key performance indicators (KPIs), key performance areas (KPAs), standards, etc. have been devised and used to achieve these means.

Setting measures however require more attention than a direct linkage to the strategic requirements of performance. In order to bring about change, behaviour needs to be changed. As Goldratt [30] indicated, people will behave according to the measures put into place whether or not these measures relate to the bottom-line or not. Scott-Morgan [51] describes the importance of understanding how these measures or "rules" result in a set of "unwritten rules" that people device to achieve their desired measures. An example of this cause-effect relationship is:

Written rule:	You must be accountable for the profit and loss in your area.
Unwritten rule:	(1) Protect you area at all cost.
	(2) Ensure the quarterly reports look OK.
Underlying results:	(1) No risk-taking behaviour.
	(2) Sort-term views on the future (e.g. cash now, no future focus).

The author indicates that if this is harnessed in the correct way, the correct change can be brought about [51, p27]:

"... there is a chain of logical cause and effect that can be traced from specific business problems via the unwritten rules all the way back to the written rules and management actions that drive the company. And that means you can do something about them."

He proposes a model for identifying the unwritten rules and then relating this back to appropriate manageable actions. This framework is shown in Figure 59.

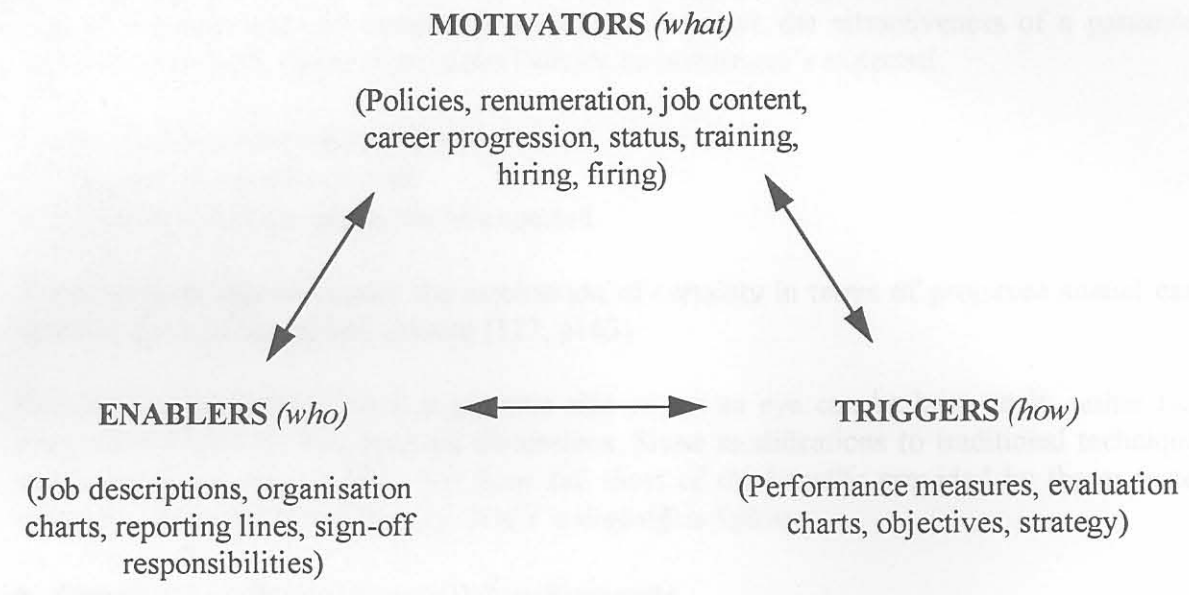

Figure 59 - Scott-Morgan's Unwritten Rules Model

Three facets need to be understood when uncovering the unwritten rules, namely the motivators (the reasons people do things), the enablers (who does what and how they fit into the organisation) and the triggers (how the who go about achieving what). The authors indicates in his experience for each of these three facets, three types of risk exist that need to be managed in order that changes be successfully managed through implementation. The matrix of these side effects is shown in Table 45.

Table 45 - Unwritten Rules and Risks of Business Change

Perceived Pressure: New vs. Existing	**Side Effects Caused by Conflicts**		
Weaker	Lipservice CYNICISM	Isolation IMPOTENCE	Rebellion ANARCHY
Balanced	Subversion TORTURE	Power Play CIVIL WAR	Camouflage GRIDLOCK
Stronger	Sabotage SUICIDE	Conspiracy TREACHERY	Paranoia PANIC
	Motivators	**Enablers**	**Triggers**
	Derivation of these unwritten rules that conflict with the initiative.		

The nine risks listed in the table are barriers to the successful transition from the de facto business situation to the new derived solution. Being able to understand the unwritten rules and their interaction in business dynamics provides a key to unlocking the human gates to change.

The scope of this technique must however be evaluated to determine where it can be effectively employed. It focuses only on practices internal to an organisation (the internal drivers) or where actions and behaviour can be conducted by the people within the organisation.

(h) Ishikawa diagrams

Ishikawa or wishbone diagrams are used as mental maps which assist in deriving a set of core problems or risks. The technique was made popular in the continuous improvement environment as a means of highlighting root causes. A representation of this, as applied to the risk management environment, is given in Figure 22, Figure 23 and Figure 24 [55]. In these diagrams Martin aims to highlight generic risks found during 3 phases of business risk of a BPR initiative.

This study recommends the causal loop diagram, mainly because of its ability to integrate more significantly with other techniques, e.g. simulation. Where the Ishikawa diagram approach is entrenched in practice, it follows that its sustained use may be more prudent.

(i) Expected monetary value

Net present value (NPV), internal rate of return (IRR) and payback are traditional and very popular methods used by companies wishing to measure the attractiveness of a particular business investment. These dimensions indicate an investment's expected:

- Magnitude of return in real terms.
- "Degree" of return expected.
- Period in which the return can be expected.

These methods operate under the assumption of certainty in terms of projected annual cash flows in terms of timing and amount [127, p163].

Risk is often identified, but it is put one side where an eye can be kept on it, rather than integrating it into the key financial dimensions. Some modifications to traditional techniques can be used to integrate risk, but these fall short of the benefits provided by the expected monetary value (EMV) technique[1]. EMV is derived as follows:

- Quantify the relative probability of each outcome.
- Weight each outcome's financial value by its respective probability in order to derive the risk-weighted average value.

[1] The shortcoming of the other techniques are provided in appendix B.

EMV is based on mathematical expectation where expectation is defined as [106, pp46-49][1]:

Equation 6

$$E = \prod_{i=1}^{n} a_i p_i$$

where: a_i is the expected value at level i

p_i is the probability of value a_i being realised.

Moilanen and Martin [127] limit n to 3 where 3 values and probabilities are used to derive the EMV as shown in Figure 60, where:

VL is the LOWEST value, with P1 chance of this being realised;
VM is the MOST LIKELY value, with P2 chance of this being realised;
VU is the UPPER value, with P3 chance of this being realised;
L is the lowest value, with zero probability;
U is the highest value, with zero probability.

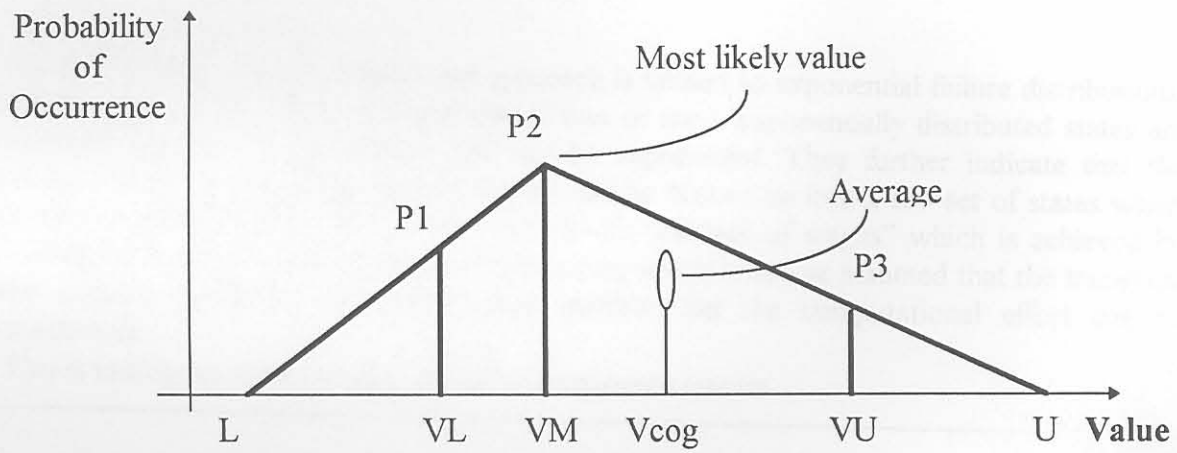

Figure 60 - EMV Triangulation

From Figure 60, a triangular distribution is assumed. The values VL, VM and VU correspond to a_1, a_2 and a_3 respectively in Equation 6. Using the triangular distribution, it is possible to establish 5 equations involving the 8 variables, namely a_1, a_2, a_3, p_1, p_2, p_3, L and U as described in appendix B. This allows for the values a_1, a_2, a_3, to be defined and probabilities p_1, p_2, p_3 and values L and U to be calculated. With this information available, it is possible to determine the EMV and its corresponding weighted-averaged probability in the distribution.

In order to derive the EMV, the following must be taken into consideration:

- Possible values for a variable within a business scenario[2].

[1] This equation has been simplified.
[2] This is the business scenario as described earlier and not different levels of a variable within a scenario.

- Relative probabilities, where they sum up to 1.
- Risk-weighted average for the variable in the probability series.

This technique is described in more detail in appendix B.

(j) Markovian modelling

The Markovian approach can be used to model events that can vary either discretely or continuously with respect to time and space[1].

Reliability problems can generally exist in a number of discrete and identifiable states and are continuous in time [133, p225], i.e. they exist continuously in a particular state until a transition occurs which brings it to another state where it resides continuously until another transition occurs and so on.

If one considers a business area as a system, then Figure 61 illustrates a simplistic Markovian state space diagram[2].

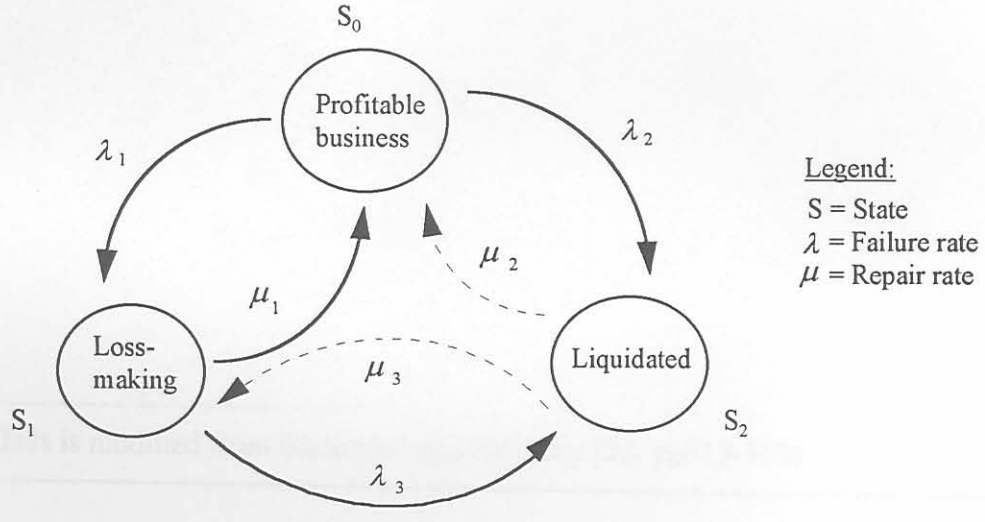

Figure 61 - Simplistic State Space Diagram

[1] It must be noted that the Markovian approach is limited to exponential failure distributions. Billinton [133, pp302-313] indicates that if two or more exponentially distributed states are combined then the resulting state will not be exponential. They further indicate that the reverse is true, i.e. a non-exponential system can be broken up into a sub-set of states which are exponentially distributed. This is done by the "method of stages" which is achieved by dividing the total time period into intervals during which it can be assumed that the transition rates remain constant. The authors also indicate that the computational effort can be considerable.

[2] This is analogous with a single repairable component system.

From Figure 61, a profitable business could result in a loss-making state or it could be liquidated although the likelihood is that it would first be loss-making before it would be liquidated. Note that μ_3 is unlikely as a liquidated business is usually disseminated or sold off in entirety. Similarly μ_2 also has a low likelihood as few liquidated businesses are restored to their former status in practice. State S_2 in this example would therefore typically be an absorbing state.

Appendix D provides some theory on the Markovian approach as well as application to an example.

While Markovian modelling suits the business change environment in terms of fit and application, it does have a few limitations, namely:

- It requires the availability of reliable quantitative information.
- The more complex the model, the more complex and labouring the computational effort required.

This does however, promise to provide a useful contribution given that the limitations are taken into consideration.

(k) Life cycle analysis

Literature provides considerable theory addressing the analysis components of the solution life cycle as highlighted by Figure 57. This trend was echoed by the market research where respondents were not currently giving much attention to issues such as operation and phase-out in terms of risk management (Figure 38). As in systems engineering where life cycle cost plays an important role, it is prudent to undertake a life cycle analysis of a business solution. Practice has indicated that downsizing exercises have promised to cut costs significantly. Sometimes however, the phenomenal retrenchment cost is not taken into account.

Key to establishing the attributes of the life cycle is the dividing of the business solution into life cycle phases. This includes all phases from problem identification to phase-out as shown in Figure 68. It is plausible to tailor the life cycle to suit the specific attributes of the solution under consideration. In order to elucidate the nature of the prospective costs, the life cycle cost profile should be constructed, an example of which is shown in Figure 62[1].

[1] This is modified from Blanchard and Fabrycky [23, pp517-519].

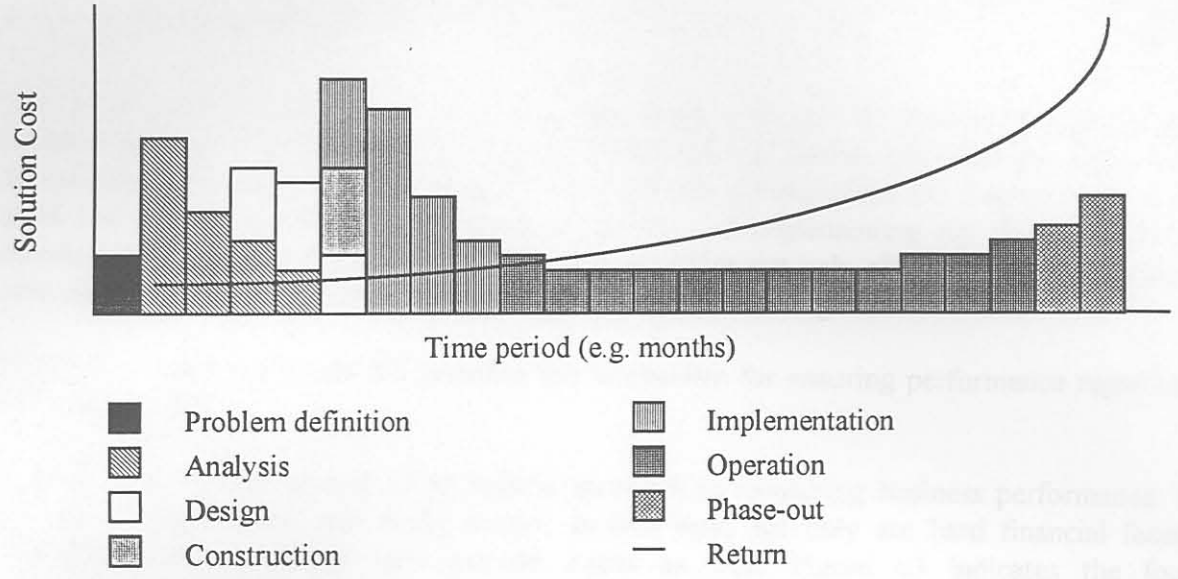

Figure 62 - Life Cycle Cost Profile

This analysis integrates well where risks and the associated management costs (e.g. insurance) are included. Risk management cost could be categorised within the various phases or it could be put into a cost code of its own in order that its magnitude and progress is made visible.

(l) Balanced scorecard

It was described earlier how important measurement is in business change. Clearly this is as critical for normal operations. The balanced scorecard [140] is an approach that has gained much popularity both in literature and in practice[1]. The outline of the balanced scorecard (BS) framework is shown in Figure 63.

[1] Many debates exist around the scorecard, but the core principles seem to have consensus from academics as well as practitioners.

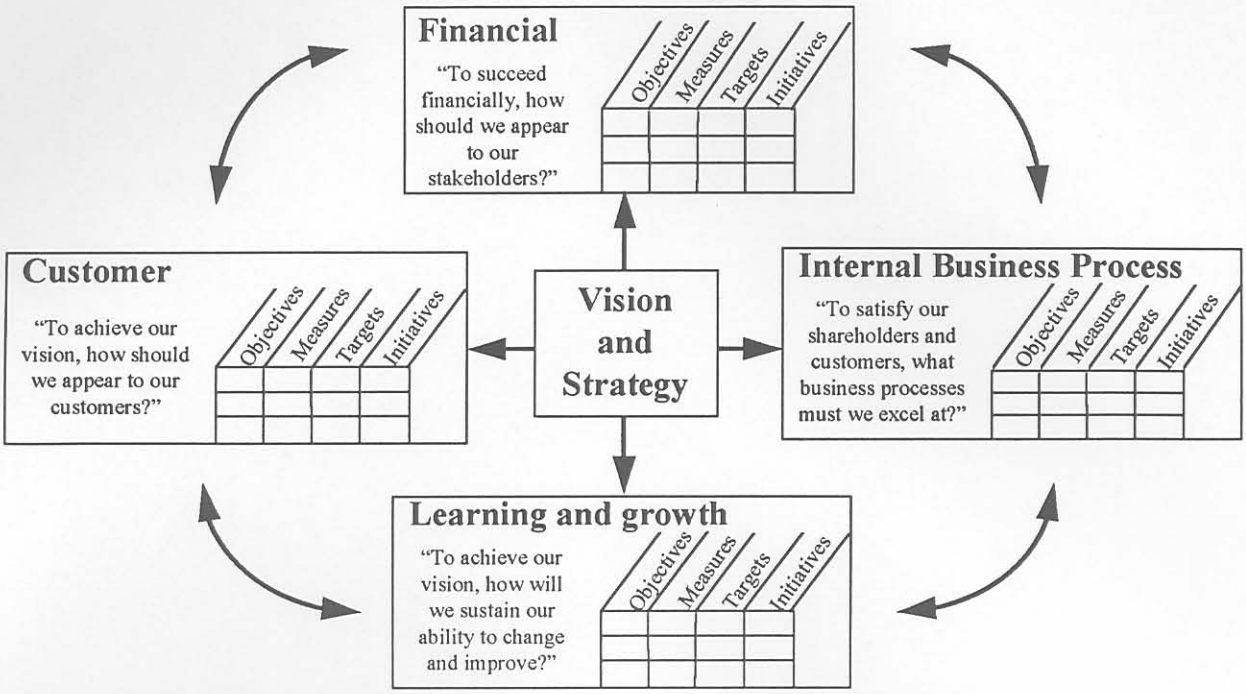

Figure 63 - Balanced Scorecard Framework

The BS provides the vehicle for taking strategy and enacting it. It provides the direct line between strategy, actions and performance monitoring. It further provides the means for formulating business strategy in a manner that contracts all employees. For example, Iscor the steel and mining corporate, has started the process of implementing the BS from senior director level down to the lower supervisory levels. This not only aligns actions but directly contracts individuals to the achievement of the strategies and targets.

It follows therefore that the BS provides the mechanism for ensuring performance regarding risk management.

The BS is so named because of its holistic approach to measuring business performance. It focuses on those areas that really matter. In this way, not only are hard financial facets measured, but the longer term growth issues as well. Figure 63 indicates the four perspectives, namely[1]:

- Financial.
- Customer.
- Internal business processes.
- Learning and growth.

In these perspectives a number of objectives exist that are derived from the strategy. A set of measures are established to ensure the monitoring of the progress of these measures. For each

[1] The researcher has used a variation of the scorecard where a fifth perspective, namely holistic is added. This sometimes highlights holistic contribution which may not be categorised under the other four perspectives.

measure at least one target is set. In order to achieve these targets, business initiatives or actions are set under way. Progress is continuously monitored via these measures.

3.7 Chapter conclusion

This chapter has provided the analysis of all the components critical to the study. It has taken current literature and practitioner experience into consideration and put forward as set of propositions. These propositions were then tested against the market by means of a market research. The findings of this research then helped to guide further research into the most appropriate tools and techniques relevant to the field of study. This analysis is then synthesised into a generic framework in the following chapter.