Risk management in the application of the Systems Development Life Cycle

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I , Danie Cronje, herewith declare that the language of this management report has been edited by Danel Hanekom from the South African Post Office Language Services.

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ABSTRACT

RISK MANAGEMENT IN THE APPLICATION OF THE

SYSTEMS DEVELOPMENT LIFE CYCLE

By

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The purpose of this report is to make a contribution to the South African Post Office Technology division. This is achieved by starting with a number of fundamental theoretical principles in related disciplines.

Risk management is proposed to the management in an attempt to increase the success rate of information technology projects. Concentrating on methodology is not the only answer. Management should accept that risks are part of the development process and should be managed. Even though risks appear throughout the development life cycle, management should realise that the starting phase of any systems development life cycle is one of the most crucial events. There is a saying in Afrikaans: “Goed begin is half gewin”. Meaning that if a project starts on a healthy basis, the rest should be clean sailing.

This report should provide a useful starting point for further empirical analysis since it provides an overall theoretical framework for the systems development life cycle.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Early in the 1980s, the South African Post Office identified a need to automate its counter transactions and mail centre procedures. At that stage, the South African Post Office utilised a manual financial system at corporate level that belonged to Telkom (both of them still formed part of the Department of Posts and Telecommunication), for the manual input of counter transactions performed at post offices and a manual system in the mail centres. Following a work-study investigation in 1985/6, a semi-automated system was implemented for the transactions at financial counters in various offices -- especially the larger (busier) offices in the cities.

Telkom and the Post Office were divided into two separate businesses in October 1991 with the state as sole shareholder. Due to the nature of its business, Telkom had been more technology-oriented and profitable in direct contrast with the Post Office.

During the late 1980s, in preparation for the split, Post Office management formed a special team to devise strategy plans and to determine requirements to enable the company to survive. In view of the Post Office's urgent need to become profitable, and the fact that the company paid quite a substantial amount to Telkom to use their system, one of certain strategic requirements was to implement a computerised point-of-sale system.

Comparative studies made between international Post Offices and the South African Post Office revealed that South Africa has a much wider range of counter transactions such as:

- pension payouts,
- agency services; and
- third-party payments

These entire counter transactions amounted to a total of 127 different transactions. During the 1990s, Post Offices in other countries started to automate counter transactions with automated point-of-sale systems. Due to the fact that none of them had the range of financial transactions similar to the South African Post Office, the whole exercise was less complex. All of the international Post Offices commenced automating in small increments (starting with the less complex transactions). After stabilisation, the next group of transactions was developed, and so on. The South African Post Office, on the other hand, decided to automate all the transactions on its system before implementation.

A feasibility study was done on point-of-sale systems (locally and internationally) during 1990 to find a suitable supplier. During 1991/2, tenders were invited whilst the user requirements were compiled only in 1993. As nontechnology-minded customers, the needs and business requirements were described using the Telkom system as frame of reference. The absence of the technology expertise to "translate" the requirements into technical specifications, proved to be a major disadvantage at later stages.

A task group, comprising of technology managers appointed from outside the South African Post Office with little or no knowledge of counter transactions and procedures, visited a number of countries to assess their systems. The Australian point-of-sale version was found to be a 75 per cent fit according to the then requirements. The team was of the opinion that the 25 per cent customisation was achievable. The software contract was signed and the developer started to customise the software for South African conditions.

The automation of mail centres in the international arena started in the 1980s, with the introduction of logistical systems. This gradually became a tracking system which enabled the tracking of:

- individual items;
- inventory containers (excluding mailbags); and
- transport routes.

Soon most of the international players had comprehensive Track and Trace systems, improving their service to customers while also improving on their productivity and as a consequence their profitability. The tracking systems enabled the mail centres to reliably measure and improve their delivery standards.

During 1993, a tracking system (New Zealand) was analysed and it was found to have a 60 per cent fit (operationally). Due to the outdated procedures (manual and labour intensive), it was decided to acquire the system. Operationally, it meant that most of the procedures had to be changed to adopt the system. However, the system was internationally compliant with the UPU (Universal Postal Union) requirements.

Both projects meant that the previously computer illiterate workforce had to be re-trained in the use of computers. The approach of the two projects however was different in the sense that it was headed by two distinctly different functional groups. The point-of-sale project was headed by Technology, while the Track and Trace project was headed by Operations. Furthermore, each and every change/decision required or proposed on the Track and Trace system was implemented only after ratification by all the role players. This approach led to involvement of the users from the beginning and ownership was thus immediately affected.

1.2 HISTORICAL PROJECTS

The specifics of the two different projects are discussed below (separately) not to confuse the reader.

1.2.1 Point-of-sales project

The South African Post Office has a competitive advantage over rival couriers and parcel operators in the sense of geographical coverage, especially the rural areas where the local populations are the major users of the various financial transactions offered by the South African Post Office and due to the fact that most financial institutions do not cover those areas. The POS system automates the transactions of the customers over the counter. The impact means that 1 800 post offices had to be accommodated which varied from a counter in the centre of a major city to a counter in the rural areas without electricity. The impact study was only done after the decision to acquire the system was made. The project manager was appointed by Technology (functional unit) on the basis of technical expertise. Technology personnel (without the necessary operational experience) compiled the user requirements. This led to a situation where people who “think they know what is required” compiled the requirements. No comparisons were made beforehand to establish whether it was more feasible to build a system from scratch or to buy and customise the package.

Technology personnel originated from other disciplines before the company split into Telkom and Post Office. Technology relied mainly on outside parties to advise on technical aspects. The point-of-sale system was considered very favourably for a variety of reasons such as:

- third-party payments,
- pension administration; as well as
- the proposed government lottery system.

The on-line capability would not only give the customer direct access to pension, banking and financial services, it would also give feedback information to the third parties regarding income generated during that day as well as fast tracking of postal articles.

At a later stage, when the project was under way, it was found that the software was not broken down into modules, but had one huge module with intertwined connections. This meant that if a change had to be made, no one could anticipate what the impact on other parts of the module would be. The software language used for the system was outdated, which meant that it would be difficult to obtain programmers for that particular language locally. For this reason, a group of programmers was brought in from Australia to do the programming.

Conflicts were rife from the outset of the project, since there were no clear project plans or formalised procedures. The project was repeatedly postponed due to a number of reasons, ranging from technology issues to operational issues. In the meantime, the "cash register" kept turning and the management board was informed that delays were a result of changing user requirements.

In May 1999 (and an estimated R100 million further), the project was finally cancelled after:

- project managers were frequently replaced;
- three external audits on the system revealed impeding disasters;
- outdated equipment needed was replaced (purchased at the start of the project);
- technical baselines (for example network PCTCP outdated) were changed; and
- software platforms were changed.

Currently, the South African Post Office is adapting the New Zealand point-of-sale system for the South African environment.

1.2.2 Track and Trace (Automation of mail centre activities)

As mentioned in section 1.1, the system was acquired in 1993 with a 60 per cent operational fit. From the outset, it was decided to steer this project from an operations platform. This meant that a core team (from various operational disciplines) lead the project with technology personnel seconded to the project, looking after the technical aspects of the software and hardware. The final decision regarding technology issues, however, still resided with operations. Advisors from Canada Post were brought in to steer the software changes. The budget from start to finish was set on R26 million.

Part of the initial contract was a complete set of specifications, namely: functional specification, design specification and technical specification. This meant that all the role players could acquaint themselves with the relevant issues before the project was started. From the outset, the operational requirements were compared to the functional specifications. A detailed project plan was available from day one and everyone knew what was expected from him or her. Technical issues provided for the most upsets on the projects, since there was a tendency to favour the point-of-sale project (described above). Technology, on a number of occasions, created delays in order to gain control over the project and to change the software to the "flavour of the month", but the Operations people maintained control via the management board.

Even though the project manager did not possess enough clout in the organisation, tactics to persuade regional leaders and unions were used to maintain momentum. "Buy in" and user ownership was considered the most crucial (risk) aspect of the project. Once past that stage, the "pull" effect from the end user was stronger than the "push" effect. The project was initially planned for nine months, but due to the delays, rolled out in the 13th month, R2,5 million under budget.

During the initiation process, the line managers did not understand what was required of them and therefore assigned their young understudies to the project who still had to make their mark in the organisation. Everyone who participated in the "stakeholder" meetings was given tasks (plans) to compile and submit to the steering committee for scrutiny. This, together with the fact that the group was young and enthusiastic, created an energetic environment where everyone performed checks and balances. All participants had to report back biweekly to ensure that all tasks were on track. Communication was considered high on the priority list of the stakeholder members. This in itself led to a situation where the steering committee only had to put their stamp of approval on major decisions (cost approval).

The system was implemented in June 1994 and "roll-out" was in July 1994. To date, the system is still functioning in its original state with the exception of scanning equipment (replaced with more reliable scanning equipment).

1.3 PROBLEM STATEMENT

Through the years, the South African Post Office gained a reputation for IT projects that fail. Even though the business ideas and concepts were applicable and justified, the projects still failed. Some of the projects failed completely while others were implemented but still failed the basics of project management in that timelines were overrun. Among the "completely failed" projects, there were the "shining stars" that were on track and ahead of schedule. In most cases, the Information Technology part were the main culprits.

With this frame of reference, the investigation was performed. The next chapter will deal with the results from a systems development perspective. Due to the sensitivity of the Excellpos project, project managers refused to comment, thus leaving us with the Track and Trace system. Most of the then project personnel were contractors. Therefore, extensive interviews of the technical team took place during June 2000 and September 2000 by means of the electronic mail media. The project personnel still employed by the South African Post Office were also interviewed.

The following types of questions were put to them:

Their personal experience on the different phases?

Their personal experience on the projects?

What could the team have foreseen by means of risk management?

How can risk management be implemented?

What changes can we make to our approach?

1.4 OBJECTIVES AND METHODOLOGY OF THE REPORT

Now that it is clear what has happened on the two most important technology projects during the early 1990s, it is essential for the South African Post Office to focus on the complete project life cycle and identify the shortcomings in the process. The focus of this management report is on one part of the overall life cycle, the risks in the systems development life cycle.

A project consists of various life cycles of which the systems development life cycle (SDLC) is but one. During discussions with my sponsor, it became clear that corners are cut during the systems development life cycle due to project managers not understanding the consequences. Another aspect is that project managers in the South African Post Office has no realisation of risks involved in the actions taken. It is my view that the implementation of a measure of risk (for example, formal risk management plans), will ensure that management formalise actions and steps of the systems development life cycle. The goals of this report are therefore to: define risk management (RM), discuss the reasons why risk management has to be implemented, and provide a guideline for implementation.

My sponsor has already indicated that the South African Post Office neglects the first step of the systems development life cycle, namely determining requirements in all the technology projects.

The objectives of this report are to:

- ✓ Provide a document for use by the South African Post Office project management
- ✓ Provide an outline of risk management during the systems development life cycle
- ✓ Provide an overview of a systems development life cycle
- ✓ Provide a guideline for risk management implementation

NOTE: This document will address only the internal factors (and forces) of the systems development life cycle and exclude the externalities. Externalities are those elements which do not form part of the systems development life cycle process directly, and are external forces bearing influences on the course of action.

The author would like to thank the following people:

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CHAPTER 2
THE SYSTEMS DEVELOPMENT LIFE CYCLE
- A PERSPECTIVE

2.1 INTRODUCTION

An information system integrates five components - people, procedures, data, software and hardware. When a system is computerised, many activities formerly performed by people following procedures are instead done by hardware executing software. The skills the people need and the procedures they perform will change, but both will be evident in a well-designed information system. Systematic, disciplined approaches to systems increase the probability that they will be developed efficiently and exhibit desirable characteristics. This chapter presents different models of system development and presents a model for the South African Post Office.

2.2 DEFINITION OF THE SYSTEMS DEVELOPMENT LIFE CYCLE

In order to accomplish any given set of tasks effectively, one must have a work plan or procedure. Without a procedure, activities are performed in a haphazard manner with little or no coordination. A life cycle is any definite period of activity that has a definite start (inception) and finish (termination). A typical cycle begins with the identification of -

- the objectives of the portion of the product being elaborated
- the alternative means of implementation
- the constraints imposed

The next step is to evaluate the alternatives relating to the objectives and constraints. Frequently, this process will identify areas of uncertainty that are significant sources of risk.

The overall work plans for a system development is called systems development life cycle and the detail plans are called methodologies. The life cycle model divides the life of a system into two phases: development and production. In the systems development phase, the system is created or revised. After the development, the system becomes part of the ongoing process of business; data is entered and reports are produced. This operational period of a system is called the production phase.

McLeod (1996:12) defines the systems development life cycle as a project with phases: initiate, determine feasibility, plan, estimate, execute, and terminate.

Theoretically, the life cycle phases of a system can be defined as follows:

- Conceptual
- Definition
- Production
- Operational
- Divestment

The first phase, the conceptual phase, includes the preliminary evaluation of an idea as well as the risk analysis and resulting impact on time, cost, and performance requirements. Therefore, the systems development life cycle includes both hardware and software development. In the next section the phases are broken down further to provide an overall framework.

2.3 THE SYSTEMS DEVELOPMENT LIFE CYCLE MODEL

2.3.1 INTRODUCTION

Before we can determine what type of model to apply to project management, one has to determine the type of system. Hughes and Coterrel (1999) have categorised systems as follows:

- *Information systems versus embedded systems*. The difference is that the information system interfaces with the organisation, whereas the embedded system interfaces with the machine. An example of an information system is SAP while an example of an embedded system is an air-conditioning system for a building.
- *Objectives versus products.* A project to meet certain objectives means that the method of reaching the objective is flexible as long as the objectives are met. In contrast, a products-driven project which has certain requirements on "how to" develop the product.

Many system development projects have two stages. The first stage is an objectives-driven project, which results in a recommended course of action and may even specify a new software application to meet identified requirements, for example, systems where hardware and platforms have been part of the requirements.

2.3.2 SYSTEM CLASIFICATION

Hughes and Cotterrell (1999) identified four types of system namely:

- *Open systems* are those that interact with the environment, which are nearly all systems
- *Closed systems* are those systems that have no interaction with other systems.
- *Suboptimisation systems* are those that as a subsystem works at its optimum, but have a detrimental effect on the overall system.
- *Sociotechnical systems* are those that require both a technological organisation and an organisation of people. For example, software projects where the project requires the project manager to be technically equipped as well as have people skills.

2.3.3 COMPARISON MODELS

Systems development can be explained in the form of a life cycle. Some system life cycles suggest that there are a number of identifiable and discrete stages, each of which is completed before the next stage commences in earnest (Example: Waterfall Process Model). Other models suggest that the process is interwoven and highly complex and although the stages are identifiable, they each form part of a continuous process.

The next table summarises the most popular systems development life cycles.

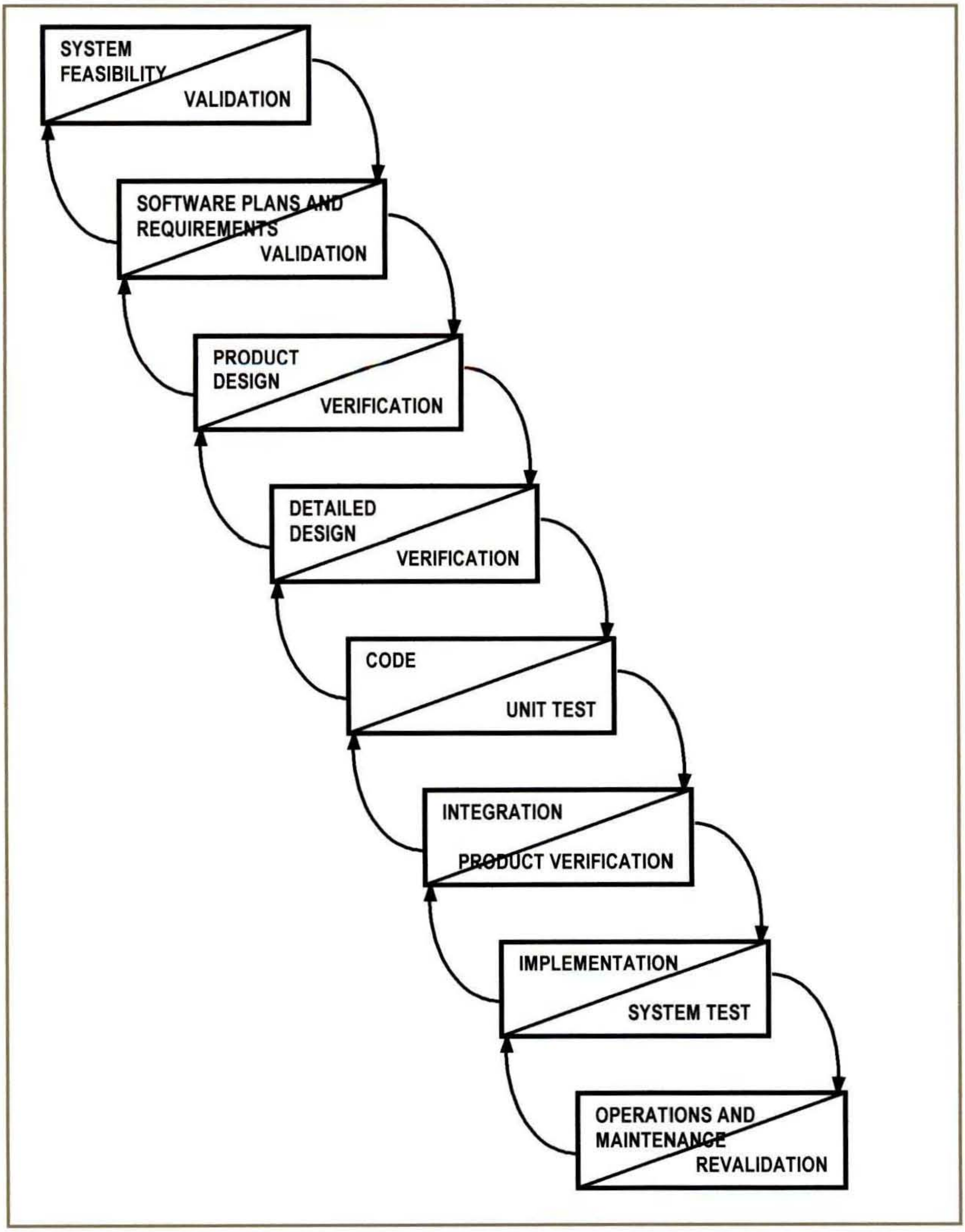
Systems development (Ahituv and Neuman 1990, p 268)	**Waterfall model** (Humphrey, 1989, p 250)	**Structured life cycle** Yourdon, 1989, p 89)	**Socio-technical** (Mumford, 1981, pp 7-18)	**Spiral model** (Boehm, 1989, p 29)
Preliminary analysis	System feasibility	Survey	Describing organisational system	Concept of operation
Feasibility study	System requirements			System requirements
Information analysis	Analysis	Analysis	Analysis of existing system	Evaluation and analysis
Systems design	Program design	Design	Design organisational system	Design, validation and verification
Programming	Coding	Implementation	Implementing the system	Coding
Procedure development		Acceptance test		Testing
Conversion		Database conversion Installation		Implementation
Operation and maintenance	Operations			Operations
Postaudit				
Termination				

2.3.4 THE WATERFALL MODEL – A PERSPECTIVE

The waterfall model was a highly influential model in the 1970's. It provided two primary enhancements to the previous (popular) model – stagewise model:

- Recognition of the feedback loops between stages, and a guideline to confine the feedback loops to successive stages to minimise the expensive rework involved in feedback across many stages.
- An initial incorporation of prototyping in the system life cycle, by means of a "build it twice" step running parallel with requirements analysis and design.

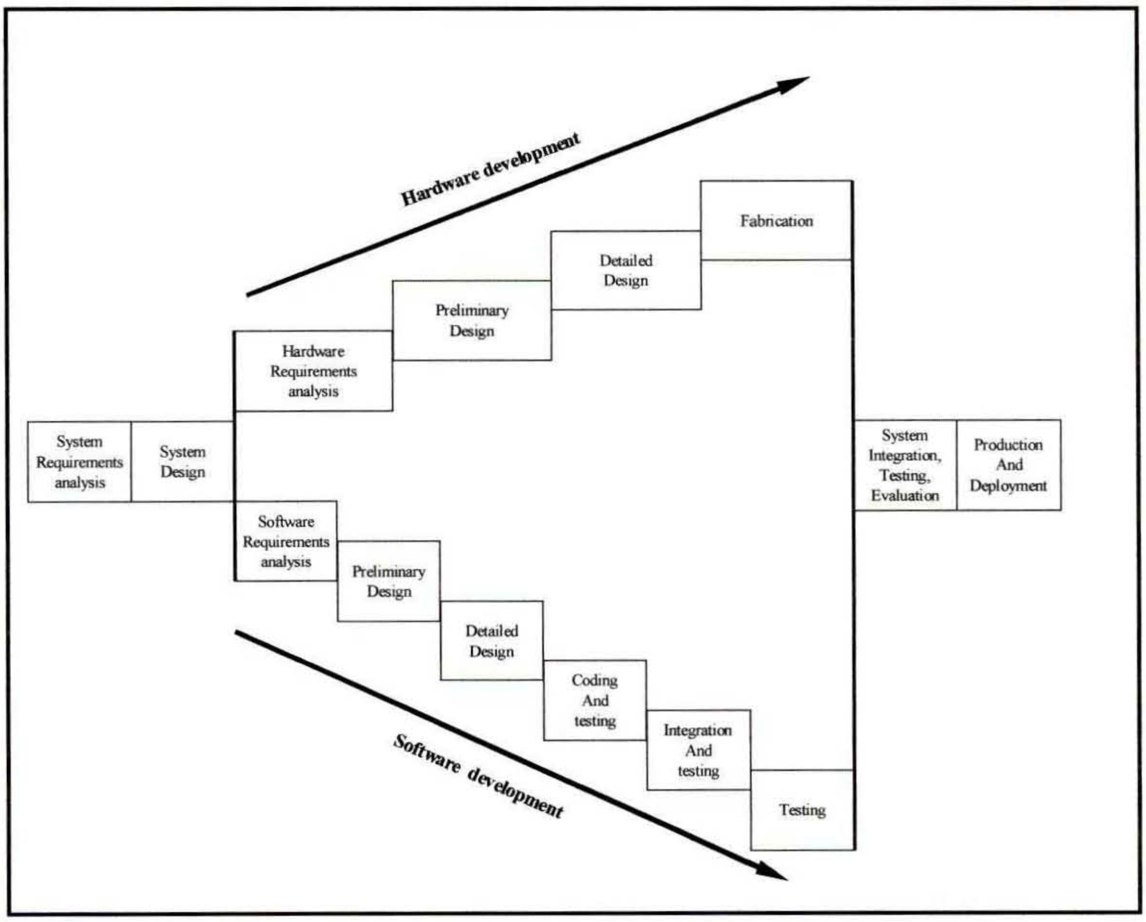
Hughes and Cotterel (1999:65) describe this model as a "classical" model. They also name the model the *one-shot* approach. They describe the model as a series of activities, in sequence, working from top to bottom. The waterfall model, in contrast, (see below) shows arrows pointing upwards and downwards. This indicates that at a later stage there might be scope for rework of the previous activity. Hughes and Cotterel also see the limited scope for iteration as one of the strengths of the waterfall model. On large projects, iterations might be problematic since the rework might change the course of action.



Source: Boehm W.: 1981; *Software Engineering Economics*, Prentice-Hall, Englewood Cliffs

Given this model, it can be argued that for different types of project, different activities are required. The waterfall model leans itself to customisation. In the event of a system encompassing designing new hardware as well as software, the activities can be customised to suit the needs. The sequence still stays the same.

For example, the military standards for developing defence systems in the United States of America prescribe this approach in their documentation (DOD-STD-2167A). The figure below is an example of a system development whereby hardware and software have to be developed.



Variations in different types of system development are as follows

- Complete system development
- Software development only
- Hardware development only
- Software modifications
- Hardware modifications
- And combinations of the above

Yeates (1991:p22) states that the standards for the development of new systems vary. However, the basic building blocks are the same in all cases and are

- Feasibility study
- Analysis
- Design
- Programming
- Testing
- Implementation
- Postimplementation support

Once the different steps have been finalised, the phases are broken down into activities that are inputted on a project management software tool for easy tracking. A brief outline of the various activities is listed in Addendum A.

But, the model lacks a clear definition of risk management and how to apply it. The question arises on which part of the model should risks be managed? Should the project manager deal with all the risks up front or should the risks be spread out over the complete life cycle? The next section deals with risks in the systems development life cycle.

2.4 CONCLUSION

I have argued (in chapter 1) that information technology projects in the South African Post Office are inherently very risky and provided reasons why the management report is focused on the systems development life cycle. In this chapter, I further provided the necessary background on the various terminologies and encompassing concepts of the systems development life cycle. The next logical step in the process is to deal with risks. All Information Technology projects bear risks that need analysis and management, though, in practice, formal risk analysis seems to be distinctly a minority pursuit.

CHAPTER 3

SYSTEMS DEVELOPMENT LIFE CYCLE RISKS - A PERSPECTIVE

3.1 INTRODUCTION

The waterfall model, as discussed in chapter 2, is applicable to the South African Post Office projects, but the South African Post Office needs to address the shortcomings of risk management. This chapter addresses risks in general as applied to the systems development life cycle and provides a basis for chapter 4 which deals with the application of risk management in the South African Post Office.

3.2 THE PROCESS OF MANAGEMENT

No discussion about risk management is justified without explaining what is meant with "management". Daft (1994) explained that management decisions fall into one of two categories, namely programmed and nonprogrammed.

> *Programmed* decisions involve situations that have occurred often enough to enable decision rules to be developed and applied in the future. Programmed decisions are made in response to the organisational problems. Programmed decisions concern that type of skills required. Once managers formulate decision rules, subordinates and others can make the decision, freeing managers for other tasks.
>
> *Nonprogrammed* decisions are made in response to situations that are unique, are broadly defined and largely unstructured, and have

important consequences for the organisation. Nonprogrammed decisions often involve strategic planning, because uncertainty is great and decisions are complex. Nonprogrammed decisions would include decisions to build the new system and develop a new service into a new environment. The decision rules or techniques for solving this problem do not exist.

3.3 CERTAINTY, RISK, UNCERTAINTY AND AMBIGUITY

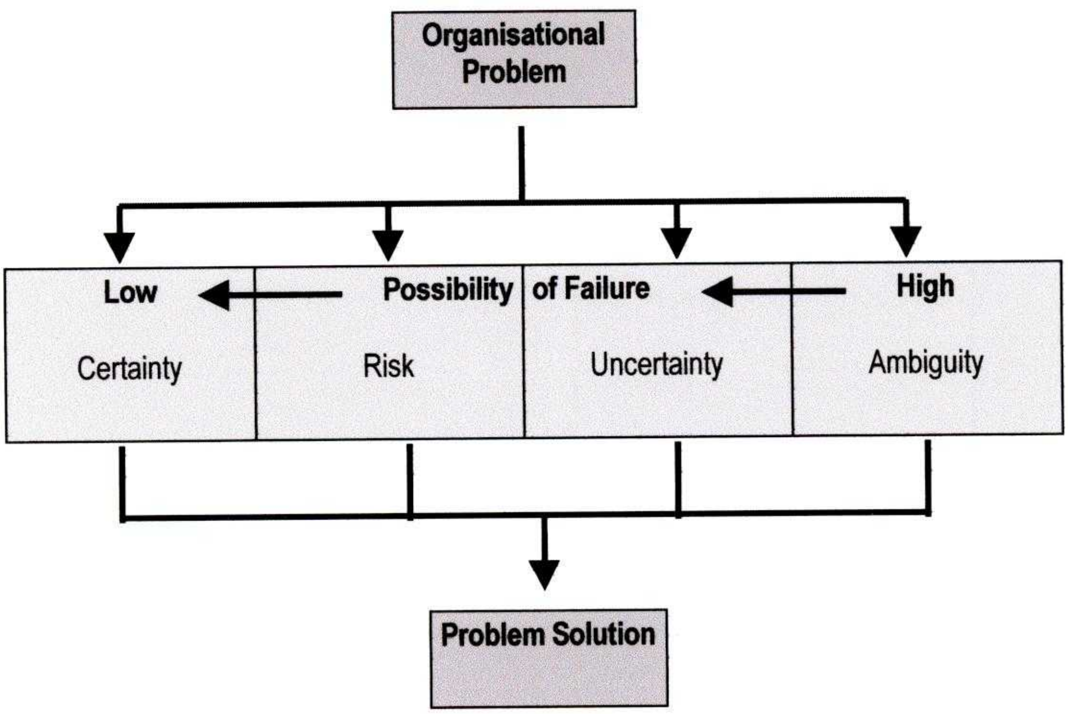
In the perfect world, managers would have all the information necessary for making decisions. In reality, however, some things are unknowable. Every decision situation can be organised on a scale according to availability of information and the possibility of failure.

Certainty. Certainty means that all the information the decision maker needs is fully available, managers have information on operational conditions, official costs, and each course of action and possible outcome. However, few decisions are certain in the real world. Most contain risk or uncertainty.

Risk. Risk means a decision has clear-cut objectives and information is available, but the future outcomes associated with each alternative are subject to chance. Statistical analysis might be used to calculate the probabilities of success or failure. The measure of risk captures the possibility that future events will render the alternative unsuccessful.

Uncertainty. Uncertainty means that managers know which objectives they wish to achieve, but information about alternatives and future events is incomplete. Managers do not have enough information to be clear about alternatives or to estimate their risk. Factors that may affect a decision, such as price, production costs, volume, or future interest rates, are difficult to analyse and predict. Managers may have to come up with a creative approach to alternatives and use personal judgements to determine which alternative is best.

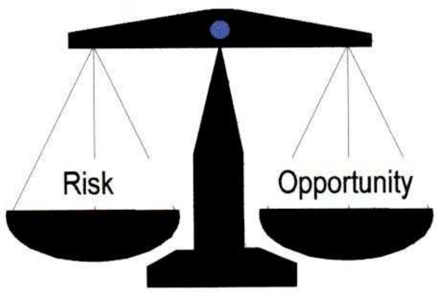
Ambiguity. Ambiguity is by far the most difficult decision situation. Ambiguity means that the objectives to be achieved or of the problem to be solved are unclear, alternatives are difficult to define, and information about outcomes is not available.



3.4 RISK DEFINED

Risk is a combination of the probability of a negative event and its consequences (Chapman:1997). Anything that is not well understood, anything that is not well documented, and anything that can change creates a risk to the project. A golden rule is: "Things that haven't been tested" are always at risk.

Risk is part of any activity and can never be eliminated, nor can all risks ever be known. Risk in itself is not bad; risk is essential to progress, and failure is often a key part of learning. But we must learn to balance the possible negative consequences of risk against the potential benefits of its associated opportunities.



Even if we're not familiar with the formal definition, most of us have an innate sense of risk. We are aware of the potential dangers that permeate even simple daily activities, from getting injured when crossing the street to having an accident with the family car on your way to work.

Anyone thinking of the term risk might ask himself: Can it be managed? or, Isn't risk rather unpredictable? To both these questions the answer is yes and no. Let me clarify by first explaining the nature of risks and then why it can be managed.

Nature of risks

Chapman(1997:7) states: "A source of risk is any factor that can affect project performance, and risk arises when this effect is both uncertain and significant in its impact on project performance." Setting tight cost and time targets makes a project more cost or time risky. Conversely, setting slack time or quality requirements implies low time or quality risk. Whatever the underlying performance objectives, the focus on project success and uncertainty about achieving it leads to risk being defined in terms of a "threat to success".

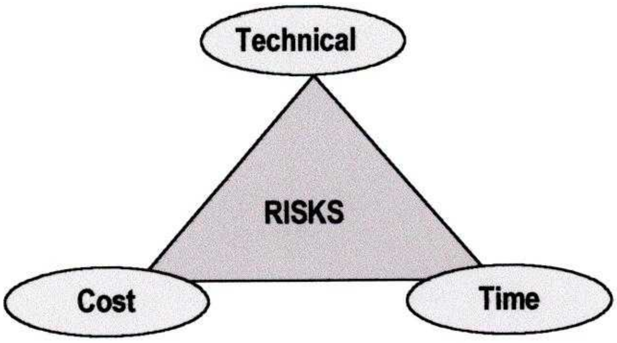
Manageability of risks

Risks are a major influence on the success or failure of a project. They must be managed by applying a conscientious effort to their reduction or elimination. Not all risks need to be eliminated entirely; often it is sufficient to reduce the project's exposure to a level that is acceptable to the project. Risk management costs time and effort, but the rewards can be significant. Without risk management, the danger of failure is magnified. Projects generally involve large, expensive, unique or high-risk undertakings, which have to be completed by a certain date, for a certain amount of money, within some expected level of performance.

3.5 MANAGING RISKS IN THE LIFE CYCLE

3.5.1 A PERSPECTIVE

In the evolution of project management, the traditional schedule, cost and technical (quality/scope) aspects of a project have been considered as the main objectives of project managers - Better known as the "Iron triangle".



If one of the components is not achieved, the project manager cannot claim a successful project

How well the project is managed depends largely on the effective implementation of a programme in which the relationship between the schedule, cost and technical parameters is optimised. As pressures to complete more effectively and efficiently for business opportunities increase, companies have been striving to refine and redefine their project management practices to comply with customers' contractual requirements and thus increase their customers' satisfaction. Customers no longer accept unanticipated, surprised risks in their projects' executions. More and more project managers learn the hard way that successful implementation of project management requires not only other traditionally accepted management approaches, but also a formal, effective risk management approach that provides a basis for mitigating impacts associated with the project and its suppliers' structure.

Because of the high competitiveness and state-of-the-art technology advances caused by changing market conditions, companies need to adopt and implement new and effective project management techniques that will allow them to survive and profit in tomorrow's project-driven environment as well as fulfil potential business globalisation strategy requirements in the coming years. Risk management is a technique that identifies a concern that threatens the success of a project and focuses the project management attention on this concern. This proactive approach gives project managers time to identify possible alternatives, develop action plans and select those that are most consistent with the project's alternatives. Since risk has always been an integral part of a project and associated with uncertainties, risk management is a systematic approach to evaluate the uncertainty, isolate the critical ones, and formulate cost-effective methods for minimising those uncertainties.

Cash (1992) explains, "In discussing risk, we are assuming that the manager has brought appropriate methods and approaches to bear on the project – mismanagement is obviously another element of risk. Implementing risk control is what remains after application of proper tools. Also, we are not implying that risk is bad. These words denote entirely different concepts, and the link between the two is simply that higher-risk projects must have potential for greater benefits. The typical project feasibility study covers exhaustively such topics as financial benefits, qualitative benefits, implementation costs, target milestones and completion dates and necessary staffing levels. In precise, crisp terms, the developers of these estimates provide voluminous supporting documentation. Only rarely, however, do they deal frankly with the risks of slippage in time, cost overrun, technical shortfall or outright failure. Rather, they deny the existence of such possibilities by ignoring them. They assume the appropriate human skills, controls, and so on are in place to ensure success."

Rodney Turner (1993:236) defines risk management as follows: "Risk management is the process by which its impact is reduced." Risk management in essence is a discipline, which objectives are to identify, address, and eliminate risk items before they become threats to the project by either abandoning the project or necessitating rework. In addition, risk management provides an improved way of addressing and organising the systems development life cycle. Risk-driven approaches also show how and where to incorporate new technologies such as rapid prototyping, fourth-generation languages and commercial software products into the systems development life cycle, and help managers determine how much of a given activity is enough.

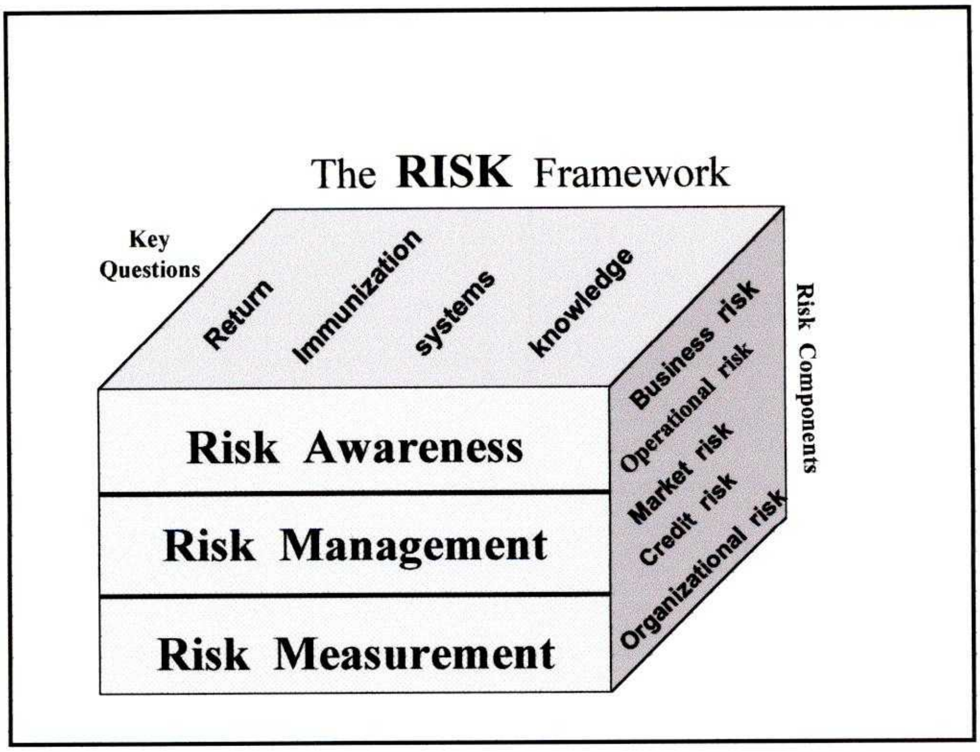
James Lam (Chief Risk Officer of Fidelity Investments) uses a RISK framework to clarify risk and its involvement. The same framework can be used in information technology projects.

"R" is for return: Are we achieving an appropriate return for the risks we take?

"I" is for immunisation: Do we have the controls and limits in place to manage risks?

"S" is for systems: Do we have the systems to measure and report risk?

"K" is for knowledge: Do we have the right people, skills, culture and incentives for effective risk management?



Source: Fidelity Investments

An Arthur Andersen survey of CEOs, presidents and board members at more than 150 global companies, reveals the need to look more carefully at information technology risks based on the following:

- One in three senior executives does not have any information technology risk management process in place; only half of those who do, are confident the process is strong enough.
- Two out of three executives say their companies do not understand information technology-related risks well enough.
- Only 13 per cent of executives believe information technology strategy is well integrated with business strategy.
- Technology professionals are responsible for the daily management of information technology - related risk at 51 per cent of companies

Source: "Managing Business Risks in the Information Age" a study by Arthur Anderson and the Economic Intelligence Unit Ltd (EIU), 1998.

The desire to build information systems across functional boundaries is also not new. “A disadvantage of being preoccupied with organisation charts is that it becomes difficult to cut across departmental lines in developing the kind of system which ties together different departments and divisions,” observed a manager at General Electric in 1960.

Firms that do develop new applications must do so in a new way. Organisations commonly tailor application packages to fit existing business practice, with the result that most business applications are functionally oriented - marketing systems solve marketing problems, sales systems solve sales problems, manufacturing systems solve manufacturing problems. Davenport (1993) argued that such “stove piped” systems cannot support a process view of the organisation; they imprison data within functions, so that new product designs cannot be released to engineering, sales data cannot be transferred to manufacturing, and customers for one product who might be customers for another product cannot be identified.

Having identified potential opportunities and constraints, their relevance to the process under analysis must be determined. Opportunities must be researched to determine how the technological or human innovation might be employed in the process. Constraints, on the other hand, are usually better examined through discussion than research. Which of the constraining factors should be accepted as constraints, and which should the organisation try to overcome? Analysis at this point is still quick and at a high level, but it provides a better understanding of which enablers will become part of the process vision and also how they will be employed in the process.

3.5.2 RISK FACTORS

Throughout the literature study of the waterfall model, risks were categorised in two classes – those of internal factors and of external factors. The following list of factors was compiled which could either act as quality of process measurement or as risk indicator.

3.5.2.1 Internal factors

The internal factors are those that have their origin within the project itself. Internal factors to a large extent are controllable. Internal risk factors can also be named critical success factors. Critical success factors are those factors that have a direct bearing on the outcome of the project and can cause the termination or failure of a development project. The following list contains typical factors to consider in the systems development life cycle. The factors are grouped according to the relevant phase of the life cycle.

Project planning and initiation

- The scope, objectives and boundaries of the project should be clearly understood
- Approach best suited for the type of project
- Determination of management approval and their commitment levels
- The service request (requirements) detailed, relevant and complete
- Determination of business case risks
- Training requirements of team members.
- Work breakdown structure – schedules for every phase

- Team structure for every phase
- Communication channels
- Stakeholder's commitment
- Deliverables list
- Assumptions and rationale for estimates, schedules and contingencies
- Financial plans
- Communication plans
- Risk and contingency
- Conflict management plans
- Loss management plans

System requirements analysis

- Methods used to determine requirements.
- Investigation team skills
- The use of market sector specialists
- Modelling of requirements
- Requirements confirmation by user management
- The number of design alternatives for evaluation
- User understanding and commitment
- Cost and benefit analysis
- A thorough route map
- Realistic and coordinated plans for delivery of system

Product evaluation and recommendation

- Evaluation of vendor proposals and their relations
- Costs and benefit summation
- Evaluation criteria, for example functional requirements, technical requirements, business requirements
- Formal request for proposal procedures
- Adequate training plans for skills transfer
- Change management procedures
- Realistic implementation and milestones
- Users must agree to deliverables
- Change control procedures
- Functional alternatives restrictions

Technical system design

- Design standards should be appropriate to environment
- Design properly coordinated with user procedure
- Technical design team skills (specialist flexibility)
- Change control procedures
- Hardware requirements documented and mapped
- Details of technical design
- Maintainability of finished product
- Enhance ability after delivery
- Programming standard appropriate
- Configuration management procedures
- Communication between users, operations, support staff
- Testing approach (phases or once)

System and acceptance testing

- Objectives detailed
- Test data (relevance and volume for stress test)
- Resources availability
- Plans for parallel running - if required
- System ability to run without assistance from technical people
- Day-to-day problem-solving and monitoring
- Error-handling procedures
- Input–output controls and analysis
- Test plan documentation and actions

3.5.2.2 External factors

There are a few factors encompassing the systems development life cycle, bearing an outcome of activities. A term generally used is influencers. A brief discussion follows to clarify the reason why these influences can affect the outcome.

Organisational culture

Information technology departments do not give the necessary attention to organisational structures and processes, as they should do. Information technology departments too often ignore the impact of new technology on the way work is organised and on job design. Through the years, technologists became accustomed to the idea of "user-friendliness". The part of user-friendliness has been recognised for its importance due to system user dependence. Any system implemented relies on the user inputs for its effectiveness.

Preliminary study

A study conducted in the United Kingdom in 1996 (Report to the Economic and Social Research Council: 1996) revealed that investigation teams rarely dig deeper than the surface or face value of systems. Their findings also proved that "most organisations are not good at evaluating the performance, impact and effectiveness of their investments". In the report it was also stated that organisations do not perform a careful, systematic evaluation of the operational performance of investments against their objectives. The main reason given was due to politics. Managers perceived that it is not in their best interest to perform such an evaluation. Problems in this area are compounded by the fact that prespecified objectives are often political statements to persuade senior managers to make the investment, rather than a commitment to expected levels of performance.

Performance of Information Technology

According to the study done in the United Kingdom (Report to the Economic and Social Research Council), 80 to 90 per cent of new investments in systems fail to meet their objectives. Some of the researchers stated that no systems in their experience had met the objectives. Evaluation of performance is considered the most difficult part of information technology projects. The same group of researchers reported that between 20 to 30 per cent of projects were successful in delivering on time and within budget. The main reasons given are that plans are altered too often for the sake of technology, poor management (generally and project), poor articulation of user requirements, inadequate attention to business needs and goals and a failure to involve users appropriately.

Purpose of systems

Cash (1992) discusses the problems related to information systems' success and identifies management policies and procedures that help to ensure the potentially high-risk projects. These risks focus on strategic vulnerabilities as opposed to the more defined implementation issues. Cash (1992) categorises the types of system as follows:

- Systems that change the basis of competition to a company's' disadvantage
- Systems that lower entry barriers
- Systems that bring on litigation or regulation
- Systems that increase customer power to the detriment of the innovator
- Investments that turn out to be indefensible and fail to produce lasting advantages
- Systems that pose an immediate threat to large established competitors
- Inadequate understanding of buying dynamics across market segments
- Cultural lag and perceived transfer of power

3.6 MOST COMMON SOFTWARE RISKS

Jones (1994) provided extensive data in his book on the reasons why Information technology projects fail. He also gives reasons to why, as well as possible resolutions. The table below is his summary.

Management Information Systems Risks

Risk factor	% of projects at risk
Creeping user requirements	80
Excessive schedule pressure	65
Low quality	60
Cost overruns	55
Inadequate configuration control	50

System software risks

Risk factor	% of projects at risk
Long schedules	70
Inadequate cost estimates	65
Excessive paperwork	60
Error-prone modules	50
Cancelled projects	35

Contract or outsourced software risks

Risk factor	% of projects at risk
High maintenance costs	60
Friction between contractor and client personnel	50
Creeping user requirements	45
Unanticipated acceptance criteria	30
Legal ownership of software and deliverables	20

CHAPTER 4

RISK MANAGEMENT IN THE SYSTEMS DEVELOPMENT LIFE CYCLE IN THE SOUTH AFRICAN POST OFFICE

4.1 INTRODUCTION

With any development of an information system, one has to ask oneself the question of what value the information has. Information has many attributes, such as verifiably, accessibility, clarity, precision and cost. Four factors that are especially important for management is quality, timeliness, completeness, and relevance.

Quality. Information that accurately portrays reality is said to have quality. The data are accurate and reliable. Once a system is known to have errors, managers will no longer use it, and its value for decision-making will disappear.

Timeliness. Information that is available soon after events occurred has timeliness. The most immediate benefit of computerised management is a quick response time.

Completeness. Information completeness refers to the problem of quantification of data. Too much data lead to information overload. Managers often devise exception to the boards that contained only a few pages of deviations from target rather than hundreds of pages of raw data.

Relevance. Information relevance means that the information must pertain to the problems, decisions and tasks for which a manager is responsible.

The real challenge is to establish a system with these characteristics. Establishing such a system involves risks. The next chapter deals with a real situation whereby the South African Post Office established a system successfully, but failed the project "iron triangle" of costs, time and technical constraints. Throughout he project the operations subproject was on course, but the systems development failed to deliver on time.

This chapter will discuss the risks in sequence to the waterfall process for ease of reading.

4.2 BACKGROUND TO THE SYSTEM

The concept of tracking containers and individual items is nothing new in any logistics company, but for the South African Post Office, it was new in that operations had to make the paradigm shift from a manual system to a technology-based system.

Previously, items and containers were recorded manually, producing a number of manual reports, which had the risk of getting lost on the journey. This also resulted in external customers being frustrated with the "old and backward company". Thus the decision was made to implement the system.

4.3 SYSTEM FEASIBILITY

Before any project can start, we need to establish if it is possible and the right thing to do. There is a number of issues to consider at this stage, namely; business issues, technical issues and timing.

From the *business perspective*, the analysis revealed a number of advantages of introducing such a system. The system was to replace the repetitive manual tasks and to optimise an expensive process. No risk assessment was performed regarding the long-term financial viability. Benefits outweighed any possible risks. The argument used was that we wanted to become a world-class organisation, so we had to use world-class technology. The South African Post Office will have the capacity to offer new services to customers locally and internationally while having the flexibility of product characteristics form market to market.

From the *technical perspective*, the system could add to the value chain in that future systems could be integrated, using the data available. The system, which the South African Post Office acquired from New Zealand, was already two years old. The South African Post Office could have implemented the system as an "off-the-shelf" system, but decided to modify the software to the local protocols. The reasons given were that the platforms were old, unstable and had an outdated network protocol, which made it impossible to implement as is. One of the strongest motivators were that the old system would not cope with the volumes, since the South African volumes were ten times that of New Zealand.

The feasibility report presented to the then management board contained only the following headings:

- Objectives
- Scope
- Possible courses of action
- Pros and cons
- Recommendations

No risk assessment was performed. The investigating team did not consider the following risks:

- Acceptance by the unions
- Resources and skills available
- User capabilities, requirements and interfaces
- Organisational implications
- Features of the system
- Hardware and software
- Communication protocols

With this as the foundation, management should have realised that the chances of the system not being implemented were high. The management board gave the permission to buy and adapt the system.

4.4 SOFTWARE PLANS AND REQUIREMENTS

The consulting firm from Canada, Systemhouse, managed the software development, while a local team managed the remaining part of the project.

Deliverables produced were as follows:

- Operations environment analysis (volumes and products)
- Software requirements
- Performance requirements
- Interface requirements
- Resource requirements
- Acceptance test requirements
- Maintainability requirements

The following deliverables were not produced:

- Functional requirements
- User requirements
- Verification requirements
- Quality requirements
- Safety requirements
- Reliability requirements

The above is a clear indication of no risk management. The following deliverables were delivered after the project were 25 per cent completed which in actual fact should have been delivered during the feasibility phase:

- Functional requirements
- User requirements
- Reliability requirements

This in itself poses a major risk in that the South African Post Office would have paid penalties if the system did not deliver in the actual requirements and the contract was cancelled.

If one takes into consideration that the same team implemented the exact system in New Zealand, the documentation of the New Zealand system should have been available at the outset. This would have enabled the team to make the necessary changes for South Africa.

4.5 PRODUCT DESIGN

The South African Post Office was aware of the following capabilities of the New Zealand version:

- Accuracy
- Efficiency
- Compatibility
- Flexibility
- Expandability
- Maintainability

What the team did not consider was the fact that these and other capabilities would change if the proposed changes were made. The technical team proposed the following changes:

- Host machine (from Ahmdahl to HP)
- Oracle 6 to 7 (versions)
- SQL Forms 3 to 4 (versions)
- Operational Computer (hardware) composition
- Unix O/S 4.1.2. to System 5
- Microcomputer setup with Dos 5, Btrieve 5.1, Microsoft C, Reflection

The users on the project made changes to some of the functionalities and thereby changed parts of the application so that it resulted into a complete rewrite of certain modules. All the screens had to change to accommodate the word "South Africa". This together with the technical changes lead to a situation where the project schedules had to be changed. The above is a clear indication that the preliminary investigation was inadequate. The technical team was strongly opposed to the Ahmdahl (host), but the local management overruled their proposal due to so-called "savings". This resulted in a dispute at a later stage when it appeared that the Ahmdahl was incompatible with the software and network protocols.

The core members of the operations team had to visit New Zealand to determine the true functionality of the system. The functional requirements were changed, after the team returned from their visit. This combined with the technical changes, resulting in a four-month delay of the project.

Documentation on the following was also not provided:

- System flow charts
- Chart standards
- Chart hierarchy
- System controls
- Security and privacy
- Hardware protection
- Software protection
- Input data controls

Proper risk management could have foreseen the problems experienced by means of an in-depth technical investigation during the feasibility phase. What was imminent during the interviews was that there was enough money built into the project plan to provide for the changes. The project plan, however, did not provide for slack time. Up to this stage in the process, the project experienced 90 per cent of the risks encountered, mainly because the

South African Post Office management by now realised what was involved in an information technology project. It was the first project of its nature having an influence across functional boundaries.

4.6 CODING, UNIT TESTING AND INTEGRATION

This part of the project was without any major events. Activities that took place were as follows:

- Modification performed
- Acceptance plan and strategy
- Test cases were prepared
- Code integrity checks
- Testing of modules for errors
- Testing of complete system as a unit
- Stress tests
- Integration testing

By now the project had its fair share of uncertainties and risks. The only remaining aspect was the acceptance test, where the South African Post Office had no experienced personnel. This was resolved in that the technical team provided their time and skills to the operational people to perform the testing. There was only one aspect of the system that could not be resolved, and that was the application of the scanning equipment. This proved to be a major stumbling block until one day before the official training of the users took place. Again, the risk of hardware compatibility with the modified software was not foreseen. If proper risk assessments were conducted, this would have been identified as one of the major risks, which had to be resolved before the project started.

4.7 IMPLEMENTATION (TRANSITION)

During this phase, the development software was transferred to the production machine (HP T500). The following actions took place:

- Final tests
- Network connections were tested
- Source code were installed
- Maintenance procedures were put in place
- Training and transfer of skills took place
- Users were trained
- System was signed off

4.8 OPERATIONS

The South African Post Office initially decided to run the system parallel to the manual system for two months, but after one month in operation, the users voted to switch to production. The "settling down" month was used for all role players to familiarise themselves with the system and to find any shortcomings. Training of the users proved again to be a risk, since more than 90 per cent of the users never touched a computer. Therefore, users had to be educated in order to reduce their resistance to change.

4.9 CONCLUSION

This chapter dealt with actual events as they took place. The project team had no formal risk management plan in place, nor had the local team members experience in projects of this magnitude. If one considers that there are 28 major production sites with 8 000 users, you might consider the project team to be lucky. However, other projects in the South African Post Office are not in that same position. No major technology project was successful since the Track and Trace implementation.

During the interviews, it appeared that on the current projects, no consideration is given to risks and their consequences. Concurrent engineering principles are not employed and the team members solely rely on the waterfall process. However, the South African Post Office recently invested in a methodology process called Summit-D, which are marketed by PricewaterhouseCoopers.

In the next chapter (chapter 5), the topic of project risk management in the systems development life cycle will be addressed. The author is of the opinion that with the introduction of risk management, information technology projects will be more successful. Proper risk control will enhance the ability of management to determine in advance if a project stands the chance of being a failure.

CHAPTER 5

RISK MANAGEMENT IN THE SYSTEMS DEVELOPMENT LIFE CYCLE - PROPOSED MODEL FOR IMPLEMENTATION

5.1 INTRODUCTION

In this chapter we will deal with the aspects of managing risks through proper risk plans. No longer can the South African Post Office rely on the instincts of people to make unfounded assessments on projects. Furthermore, team members have to realise that they as individuals are contributing to the level of risks. By means of proper plans, the management board will be able to take calculated risks.

The question of any manager is "where do we start", "what are the steps", "how can risks be identified". This chapter will build a model from the basic concepts (as discussed in chapter 3) up to the finishing of a project.

5.2 PROJECT FAILURES

No discussion of any risk plan can start without investigating the history of failed projects. This is done in order to equip oneself with the knowledge not to repeat the same mistakes. The conclusion to be drawn from reviewing the main research studies (Wilcox: 1997) (See Addendum B) on risk, is that major projects commonly experience overruns, are often over budget, do not perform in the way expected, involve severe strain on participating institutions, or are cancelled prior to their completion after the expenditure of considerable sums of money. Studies suggest that these problems relate essentially to issues of size, complexity, long time-span, uncertainty, governance and management peculiar to larger-scale projects. A generic list of risks is to be found in Addendum C provided by Tera Quest.

5.3 RISK MINIMIZATION

Before any manager determines a risk plan, he/she has to know what to do when risk factors have been identified. This section is an overview of risk minimization.

An easy way to reduce risk is to have less ambitious goals. After evaluating risks, one can choose a path of risk avoidance or risk mitigation and management. If project managers understand the risks during the various phases, they can decide which risks are acceptable and take actions to mitigate or forestall those risks. If the initial risk assessment determines that the risks are excessive, one has to consider restructuring the project to within acceptable levels. Risks that do not offer potential gain should be avoided.

Cash (1992) provide various strategies available for resolving a specific risk, which are listed below:

- *Avoidance:* Make decisions to avoid placing the team in risky situations. The following is typical responses to eliminate uncertainty or risks:
  - Clarifying requirements
  - Defining objectives
  - Obtaining information
  - Improving communication
  - Acquiring expertise by training or recruitment
  - Targeting cause or source of risk by removing it
  - Changing the scope of the project to exclude risks
  - Using proven technology methodology
  - Redesigning to eliminate risk

- *Protection:* Take actions that protect you from the consequences of a risk.

- *Research:* Eliminate the uncertainty associated with a risk by learning more about it.

- *Reduction:* Take actions that reduce either the probability or the consequences of a large risk to the point where it becomes a small risk.

- *Transfer:* Shift the risk somewhere else, for example, by getting the customer to take responsibility. Many project managers opt for this kind of strategy, but one has to remember that if you do not have direct control over a task, you cannot determine the outcome. Shifting the risk to someone else might also cause other unforeseen risks. An illustration is to subcontract at a fixed price. The risks are then borne by the subcontractor. The project manager should also keep in mind that to transfer the risk to someone else is to transfer the responsibility as well.

- *Acceptance:* It often makes sense to simply accept a risk with a relatively low exposure. If the risk becomes reality, you can deal with the consequences. Residual risks remain after avoidance and/or transfer. This must be proactively managed, even if they cannot be influenced in the same way as other risks. The most common way of acceptance is by means of contingency planning. This will include time, money and resources. Other means to accept responsibility for the risks are:

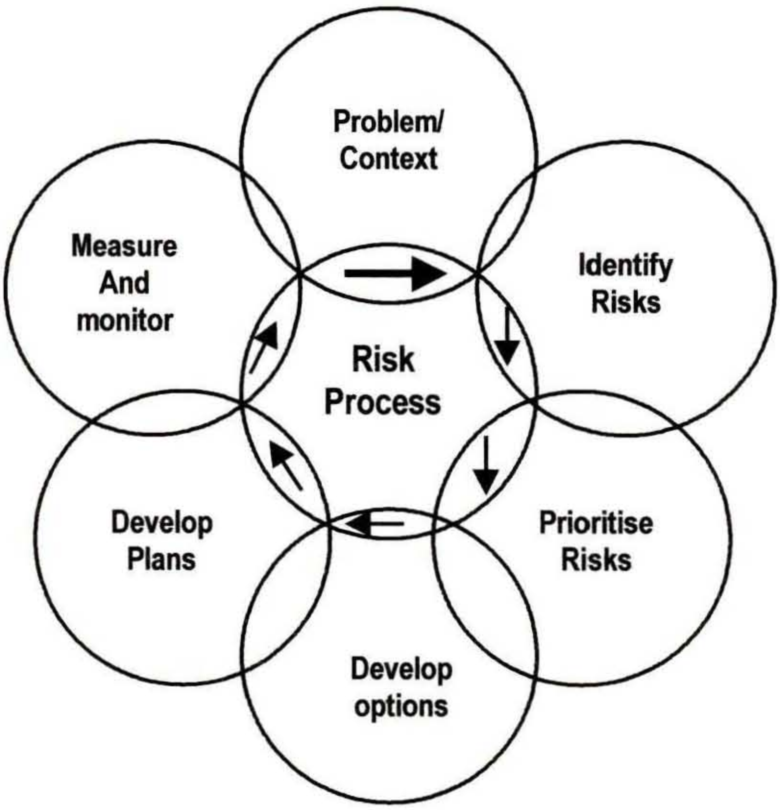
  - Development of a risk-aware culture in the organisation and on projects
  - Incorporation of risk management into routine project processes with regular reviews, reports and updates
  - Taking account of identified risk and agreed responses in project strategy, including appropriate activities in the project plan and budget.

5.4 RISK MANAGEMENT – THE METHOD

This section will deal with the risks in the systems development life cycle as applicable to the waterfall process.

The steps involved are:

1. Identify risks
2. Prioritize risks from high to low
3. Develop risk management action plans,
4. Measure and monitor action plans (risk)



5.4.1 IDENTIFY RISKS (What can go wrong and what are the causes?)

Consider the potential sources of risk and the options available for identifying risks and identify specific risk items that could compromise the project's success.

Remember that Murphy was an optimist. It's too easy for project managers to construct their models hoping that the things that could go wrong won't for their project. But that is not a level-headed way of looking at risk. If you're going to dodge the risk factors, you might as well channel your energy into completing the project and hope that divine intervention will guide your team to success. But if you want to manage your risks fairly, there are some steps that can help.

First, name your risks. One of the best ways to do this is to hold team sessions – inspections, if you will – to identify possible risks. Once you have a list of candidate risks, you should evaluate each risk and assign it a weight representing its likelihood. Following that, you must determine what will happen to the project if each risk becomes an actuality.

Given that it's impossible to reduce the likelihood of all risks to zero, you must identify the most significant risks in terms of severity, likelihood, and potential consequences.

The change constant

The biggest risk management mistake is not failing to identify risks. It's failing to continually revise the risk management plan. A software development project's environment is constantly changing, as a result of competitive pressures, organisational strategy and personnel changes and technical challenges. Too frequently, a risk management plan, like a system architecture design, is prepared at the beginning of the project and then shelved. To be valuable, risk management needs to be revisited as frequently as schedule and technical issues. Quantify the extent of each risk by measuring the risk exposure.

5.4.2 PRIORITIZE RISKS (Which risk can be responsible for the

biggest upset?)

Prioritize the identified risks in descending order of numerical risk exposure, to bring to the forefront those risks with a combination of relatively high impact and relatively high probability of occurrence.

- Document the results, using a Risk Management Log
- Develop Risk Management Action Plans
- Think through the options available for risk resolution.

One of the biggest risk analysis mistakes is confusing ordinal rankings with actual measurements. That is, if you assign a high, medium, or low ranking to a risk variable, it's inappropriate to construct a mathematical model of probability based on those rankings. A rank of "medium" cannot be interpreted as statistically significant. If, however, you assert that, a function point count greater than 100 will trigger a large project risk, you are using a measurement. Maybe a function point count of 100 translates into a medium-level risk, but you can't say a medium risk that your project will be cancelled is equivalent to the medium risk that your project will be too big. All you can say is that the risk is greater than low and less than high.

Another common mistake is confusing risk with uncertainty. Both may find a place in your spreadsheet, but you usually calculate risk. Uncertainty, by definition, negates any effort to assign a certain value to an uncertain variable.

5.4.3 DEVELOP RISK MANAGEMENT ACTION PLANS (What must be done?)

Develop a Risk Management Action Plan for each high-risk item. Ensure that each such plan is concise, action-oriented, easy to understand and easy to monitor. For each, plan how and at what cost. Make sure that the Risk Management Action Plans include specific contingency plans for high risk items.

Integrate into the detailed work breakdown structure

Ensure that the work required to implement the risk management action plans is integrated into the overall project work plans and that the costs of implementing the contingency plans are taken into consideration in the project budget. For example, if one of the risk management action plans calls for a prototyping or proof-of-concept activity, include the prototype or proof-of-concept (and the work required to develop and review it) in the detailed project work breakdown structure.

5.4.4 MEASURE AND MONITOR ACTION PLANS (RISKS)

Monitor the status of each risk and its Risk Management Action Plan and prepare a Project Weekly Risk. Report as part of the ongoing process of managing project performance. Involve the customer in increasing the visibility of risks and removing high-risk items. Focus on risks to which you can apply some form of risk elimination or containment strategy, as distinct from those over which you have no control.

Differentiate between generic risks (all of the things that can possibly go wrong on any project) and project-specific risks. Generic risks are dealt with through the standard project

Transfer of title and transfer of risk must be consistent for prime and subcontracts.

Recourse for delays

The prime contractor must have recourse for delays caused by the customer or by subcontractors.

Dispute mechanisms

There must be clear instructions for handling disagreements including problem escalation procedures.

Update provisions

There must be provisions for changes to the contracts and subcontracts, including keeping the agreements current.

5.4.5.2 RISK MINIMIZATION MEASURES FOR PREPARING WORK PLANS

Goal-oriented plans

There must be well-defined rather than broad objectives, a defined budget, reasonable schedule pressure, incremental change with well-defined intermediate states (measurable milestones), appropriate phasing recognizing the strategic aspects of the project schedule, and manage-to-budget techniques for each chunk.

Work breakdown structure method

Planning must be based on a comprehensive Work Breakdown Structure (WBS) which provides a clear and unambiguous definition of scope in terms of expected products or deliverables and work effort. The WBS must be used to identify, authorize, perform, accept, and manage all significant project activities.

Clearly assigned responsibility

Each component of the WBS must be assigned to a single point of responsibility.

Team-based, leveraging previous experience

Planning must be a group process to think through all elements of the project, clarify the scope of work, take into consideration previous experience on similar projects, and reuse or leverage existing materials to the maximum.

Realistic

The process, staffing commitments, schedules, and budgets for each subproject must be realistic.

Traceable

All subprojects must be broken down into detailed, traceable activities and tasks based on the WBS.

Balanced estimates

Estimates must be based on good estimating techniques, accurate estimating metrics and heuristics, and knowledgeable estimators, and must be accompanied by comprehensive detailed documentation of all assumptions.

Risk management

Planning must incorporate proactive identification of potential project risks and the development of plans to contain them.

Contingency planning

There must be contingency plans with fallback strategies for high-risk aspects.

5.4.5.3 RISK MINIMIZATION MEASURES FOR ORGANISED PROJECT START-UP

Clearly assigned responsibilities

There must be a clear definition of responsibility at all levels: who has overall responsibility for delivery of the project and who has responsibility for acceptance of the project on behalf of the customer, as well as who has responsibility for delivering and accepting each element of the work breakdown structure.

Optimal structures

The organization structure must be flat and non-hierarchical to the extent possible and must maximize the ability of team members to contribute to project success.

Qualified team

The team must comprise qualified personnel, including qualified subcontractors and partners, with the right person staffed to the right job.

Integrated team

There must be effective integration of the efforts of all contributors, including our staff, customer staff.

Excellent infrastructure

There must be an excellent infrastructure built well in advance (for example, System Development Environment, automated project management tools).

Integrated facilities planning

There must be effective synchronization of project planning with staffing, facilities, and other infrastructure planning. Poor planning can result in hundreds of person-days in lost productivity on a large team.

Orientation

There must be a strong orientation and training programme.

Attention to cultural concerns

Attention must be paid to cultural differences to identify and quickly resolve problems associated with different backgrounds.

Controlled environment

There must be appropriate planning and control systems providing an effective information flow.

5.4.5.4 RISK MINIMISATION MEASURES - MANAGING THE CUSTOMER RELATIONSHIP

There must be a clear and unambiguous understanding of the goals and objectives of the endeavour. The vision must be clear, articulated, and agreed upon.

Shared understanding

There must be an understanding on both sides of the broader goals and aspirations of each organization (the bigger picture), so that the project can be placed in the proper context.

Personal relationships

Successful partnerships are based on people working with people who are on honest and have integrity.

Positive attitudes

Everyone must be committed to making the project a success. No one can be thinking in terms of being right at the expense of being successful.

Realistic expectations

Everyone must be balancing fundamental principles and ideals with reasonable expectations for the real world.

Realistic commitments

The project team must commit only to work, which it can deliver successfully.

Frequent contact

There must be frequent contact and discussions with customer management and with the customer's staff.

Open communication

Communications must be honest and open, based on fact, not hearsay, so that there are no surprises.

Effective risk and issue management

There must be clear demonstration to the customer of effective risk and issue identification and problem solving.

Evidence of mutual satisfaction

Interim work products and deliverables must be evaluated with the customer to ensure that work remains aligned with the customer's required direction, and that there is evidence of mutual satisfaction.

5.4.5.5 RISK MINIMISATION MEASURES FOR MANAGING PERFORMANCE

Commitment

The management style must encourage respect for the individual and generate personal focus and clear intent to achieve customer satisfaction.

Enthusiasm

There must be a personal and collective display of excitement and interest.

Visibility

There must be visibility of responsibility and commitments, visibility of status based upon early and objective measurement of progress, full visibility and documentation of variances, issues, and changes, issue management, risk management, and financial management.

Teamwork

There must be evidence of positive morale and teamwork and evidence of stakeholder and end-user participation and understanding.

Integrated systems

The project management tools must be effectively integrated to schedule, track and account for all project work, including that of customers and subcontractors who are part of the project team. This requires that there must also be effective integration of the customers' and subcontractors' management systems with the project management tools.

Cost/schedule management

Cost and schedule must be managed proactively based on fact. The systems must provide the capability to predict final performance as accurately and early as possible. The systems must also generate early warning indicators that automatically trigger the application of additional face-to-face management experience to enable timeous, corrective action.

Measurement

There must be effective measurement techniques to identify the levels of quality and productivity being achieved and to provide a baseline for continuous improvement.

Communications

There must be effective team communication including all members, not just senior levels. Attention must be paid to ensuring effective communication processes (for example, use of LANs, WANs, effective use of meeting time).

Decision-making

Decision-making must be participative so that the right person makes the right decision information, rather than a person in the hierarchy. Everyone must be able to influence decision-making and understand the results.

Problem-solving

Everyone must be committed to understanding the issues and opportunities in problem situations and developing effective plans to achieve or resolve them.

Rewards and recognition

There must be recognition and rewards for quality service, creativity, innovation, and success.

Continuous improvement

The environment must encourage creative dissonance and continual striving for improvement within the time/cost constraints.

5.4.5.6 RISK MINIMISATION MEASURES FOR MANAGING QUALITY

Customer focus

There must be an absolute focus on customer requirements and business objectives.

Defined quality requirements

Customer expectations for quality must be examined and quality specifications must be defined with our customers.

Rigorous and optimized processes

There must be defined processes which, when followed, lead to the desired end goals. The processes must be streamlined, fast and agile and must produce work products that are consistent and rigorous.

Standards and procedures

The project must use appropriate standards and procedures, which are re-used extensively across projects.

Maximum empowerment

Each team member must be responsible for building in quality, by applying approved policies, procedures, and work instructions in accordance with the Quality System.

Quality control

Independent verification and validation mechanisms must be in place to verify that the work products produced by the processes meet the agreed-upon quality specifications defined with the customer (the producer's view), and are suitable to meet the customer's business objectives (the customer's view). There must be built-in checks to identify errors that may have occurred and to ensure effective corrective action for nonconforming items.

Quality assurance

There must be a quality assurance function to provide confidence to internal management and to customers that the intended quality is being achieved and will be sustained.

Measurement

The approach to quality must be based on rigorous measurement and optimization of the cost of quality. Prevention and appraisal costs must be controlled and optimized to minimize resultant poor quality cost.

Continuous improvement

Defective processes must be corrected to make sure that similar problems do not recur. The approach must result in the continuous improvement of the quality of our staff and work products through training, positive management, and continuous monitoring of the needs of our market.

5.4.5.7 CLIENT/SERVER RISK MINIMIZATION MEASURES

Risk minimization measures are key practices that have been integrated into the Knowledge Base methodologies to minimize quality, cost, and schedule risks, as part of a comprehensive risk management approach.

Client/server

The following outlines the key areas to examine in each stage of the Client/Server methodology, to minimize risk:

1. Concept definition
2. Functional definition
3. Structural design
4. Development
5. Implementation

1. Concept definition risk minimization measures

The following outlines the key areas to examine, in the Concept Definition stage, to minimize risk.

Proof of concept

Use proof of concept testing early to prove the proposed technology architecture of the system. Ensure that selected products actually work together and that new products are compatible with existing products. Test the communications network and distribution strategy for data and process placement to ensure that the solution meets requirements and provides maximum performance.

Implementation strategy

If the system is to be deployed in releases, is distributed, or is to be deployed at many sites, invest time and effort to ensure that issues are identified and addressed and a detailed cost/benefit analysis is completed.

Deployment in releases increases the complexity of the project and adds overhead; make sure you have built additional project management effort into the work plan.

Overlapping stages (for example, design and development) adds another layer of complexity. Plan carefully and fully assess the impact of a scheduling delay or issue in one stage on the other stage.

Plan for maintenance

Start thinking early about maintaining the system and develop a plan for the System Management Environment. By defining requirements early, it will ensure that they are included in the design and development of the application.

Prepare for the next stage

Take the time to prepare for the next stage; ensure that the System Development Environment (SDE) is ready for the analysis and prototyping activities, analysis and SDE standards and procedures are defined, a baseline requirements trace ability matrix is complete and approved by the Acceptor. This matrix is used throughout the remaining stages to ensure that requirements are met.

2. Function definition risk minimization measures

The following outlines the key areas to examine, in the Function Definition stage, to minimize risk.

Confirming requirements

One of the most expensive and time-consuming errors to correct is the result of a missed or misunderstood requirement. Develop horizontal prototypes and vertical prototypes and use these to confirm the system requirements with the end-users in workshop settings.

Begin the Acceptance Test Plan and test scenarios in parallel and use the test scenarios during the prototype review workshops. Working through a test scenario with the prototype can ensure that a requirement is really understood by the project team and may also point out missed requirements (for example, missed data item, or awkward navigation for the business process).

Before prototyping starts

Before prototyping begins, decide whether the prototype will evolve into the production system or will be used and then thrown away.

If the prototype will evolve into the production system, it is imperative that the System Development Environment is in place and the design and development standards and procedures are defined before prototyping begins.

Data conversion effort

Do not underestimate the effort required to complete the data conversion activities, including preparation (or cleansing) of the data for conversion.

Conduct a thorough analysis of the existing data structures to ensure that procedures are defined to accurately load the data into the new data structure or to make the data available to the new system by interpreting the data in its existing architecture.

To confirm the integrity of the data and determine the effort required to cleanse it, audit the data in critical files to be converted. For example, in an accounts receivable system, audit the customer, sales history, and payment history data.

Planning for deployment

Start deployment and site preparation activities early to avoid schedule impacts caused by long lead times for equipment and facility upgrades.

3. Structural design risk minimization measures

The following outlines the key areas to examine, in the Structural Design stage, to minimize risk.

Save time through re-use

Structure the system to utilize common program units, wherever possible. Build these program units early so they are available to the team. Especially ensure that common architectural components such as data access and messaging utilities, are built early and placed in the re-use library. Prepare re-use procedures and train the project team on how to take advantage of re-use.

Monitor system performance

Continually test performance to confirm the technical solution and ensure that requirements are met.

4. Developing risk minimization measures

The following outlines the key areas to examine, in the development stage, to minimize risk.

Organizing development

Itemize the program units and order their development appropriately to help with the creation of test data for unit testing. For example, in a library system, develop the catalogue maintenance program units first; these maintenance programs can then be used to maintain catalogue entries to test the check-in and check-out program units, developed next.

Likewise, try to order the development of programs to consider integration testing. For example, develop program units that rely on one another to complete a larger task in a group, to allow integration testing to begin as early as possible.

Integration testing

Invest time and effort in a thorough integration test to avoid scheduling and effort impacts during system test. In other words, to avoid rework, make sure you are ready for system testing before you begin.

Integration testing is especially important if the system test and acceptance test have been combined into one test where the project team and the end-users conduct the test together.

Test performance

Continue to test system performance throughout development. During system testing, conduct volume and stress tests.

5. Implementing risk minimization measures

The following outlines the key areas to examine, in the Deployment stage, to minimize risk.

Installation testing

Complete a thorough hardware and application installation test before cutting over to the new system at each site. Putting a new system in place is stressful for the end-users and needs to run smoothly.

Confirm conversion

Confirm the accuracy of the data conversion and loading, especially of critical data, before cutting over to the new system.

5.5 RISK MANAGEMENT ADVANTAGES

There will be a cultural shift from “fire-fighting” and “crisis management” to proactive decision-making that avoids problems before they arise. Anticipating what might go wrong will become a part of everyday business, and the management of risks will be as integral to program management as problem or configuration management.

5.6 CONSEQUENCES OR NEGATIVES OF RISK MANAGEMENT

Management will not have insight into what could go wrong – consequently more resources will be spent correcting problems that could have been avoided sooner, catastrophic problems (surprises) may occur without complete information or adequate knowledge of future consequences, the overall probability of successful completion of the program is reduced, and your program will always be in a crisis. A question asked by many business people is: If risk management is implemented, does that guarantee success? The answer is "No". There are many aspects to achieving program success. Risk management is not a silver bullet. However, it can improve decision making, help avoid surprises, and improve your changes of succeeding.

5.7 CONCLUSION

Throughout this chapter we argued that managing risks are vital. The author is of the opinion that project managers will be able to plan more effectively by analysing a project before they proceed. A typical role-player activity list is provided (See Addendum D) and an example of a risk check list (See Addendum E) to complete the discussion. If project managers take risk management in the systems development life cycle seriously, it will reduce the rate at which information technology projects fail.

ADDENDUM A

SYSTEMS DEVELOPMENT ISSUES

This list is adapted from Yeates (1991:pp 50-51)

SYSTEM FEASIBILITY

- Establish budgets
- Establish timelines
- Interview senior users
- Obtain objectives of system documented and agreed
- Do cost and benefit analysis and obtain the agreement from user departments
- Establish outline of proposed system
- Produce feasibility report
- Presentation of feasibility report to senior management
- Results of feasibility must be
  - **S**pecific
  - **M**easurable
  - **A**chievable
  - **R**ealistic
  - **T**ime targeted

ANALYSIS

- Design user questionnaire
- Collect complete set of documents for existing system
- Plan interviews with user departments
- Analyse data flow
- Document all findings
- Define inputs and outputs of system in user language
- Calculate volumes of data, both existing and projected
- Document findings and obtain user agreement
- Present to user management
- Define change control procedure

DESIGN

- Define methodology to be used for design
- Design input routines
- Design processes
- Design output reports
- Define files
- Design test and integration strategy
- Document overall design
- Define interfaces to other systems
- Design module and program test data
- Write program specifications
- User and project team design acceptance tests

PROGRAMMING AND TESTING

- Check program specifications
- Break down programs and modules to individual tasks
- Allocate tasks to programmers
- Produce code in chosen language
- Define module and link tests
- Ensure data available for integration testing
- Check quality of code
- Document all programs
- Ensure user provides acceptance test data
- Complete integration testing
- Complete acceptance testing
- Sign off system

DEVELOPMENT SUPPORT

- Define documentation standards
- Define computer resources required for each stage of development
- Decide on program development mode
- Define the quality plan, milestones and measurable achievements
- Define monitoring and control procedures
- Set up progress meetings within team

ADDENDUM B

CONDITIONS FOR SUCCESS AND FAILURE IN SEVEN MAJOR IT PROJECTS
(Willcox)

Major issues	TradeNet	Operational strategy	CRISP	Videotex (France)	Videotex (UK & Germany)	TAURUS
Strategic framework	Clear and stable	Fluctuating government policy and industrial relations problems	Control dispersed to regions	Strong fit with government planning	Control and development left to marketplace	Ill-defined and changing
Role of government	Intervention; supportive	Isolation of IT; financial support	Financial backing	Financial and technical support; coordination	Publicity and endorsement only	"Hands-off"; legislative restrictions
Organisa-tional adaption	Trade operations and jobs redefined	Coercive rather than through participation	Stakeholder resistance	New customer-supplier relationships	Little adaption; small take-up	Manual processes automated: resistance
IT supplier problems	Clear terms of reference; strong management	Some, created by time pressure and changing requirements	Poor contracting; variable standards	Run by state-owned company	Suppliers demotivated by lack of demand	Unclear terms of reference; poor management arrangements
Change management	Supportive cultural context; strong project disciplines	High use of consultants to circumvent internal resistance	Lack of user participation	Well coordinated	Lack of demand meant no real problems	Lacked coordination and control focus
Faith in technical fix	Business needs first	Technology driven	Underplayed human and social factors	Evolutionary: see how used	Overoptimistic about its usefulness	Technology driven
Market and economic demand	Seen as economic survival issue	Mainly to cut administra-tive costs	Distributive mechanism	High take-up (at subsidised rates)	Limited to specialist groups	Demand fluctuated; stakeholder ambivalence
Skills to support implementati on	Educational infrastruc-ture; additional skills imported	External technical skills used	Skills not available	Available and used	Available but not widely used	Largely bought-in
Exploration of wider options	Review combined with proto-typing approach	Technical fix updated by time pressure and IR issues	Options not explored	Yes, through evolutionary development	Technology as solution	Only after 1993 failure

ADDENDUM C

GENERIC PROJECT RISK FACTORS
Tera Quest December, 1998

A project team might use this table to prompt their thinking about risks for their project. The team can decide which factors are relevant at what rating, then proceed to state the specific risks they suspect could affect their project.

When the project has been completed, the team should review its performance with risk management and see if there are factors to add to this table or if there are cues that should be changed to help future projects in the organisation better identify their risks.

Material in the risk factor table is organised with the following headers:

Project Domain	Name for an area in which projects might be done, with risk factors in this table generally found in this type of project.
Factor ID	A sequentially assigned number for risk factors in this domain. When new factors are added, they get the next available sequential number, thus items within a category may not be in numerical order.
Risk Category	A header that names the category in which the following risk factors belong.
Risk Factors	Named areas of potential risk to projects in this domain.
Low Risk Cues	Characteristics of this factor when it can be considered low risk to a project.
Medium Risk Cues	Characteristics of this factor when it provides a medium risk to a project.
High Risk Cues	Characteristics of this factor when it should be considered high risk to a project.

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
	Mission and Goals			
1	Project Fit to Customer Organisation	Directly supports customer organisation mission and/or goals	Indirectly impacts one or more goals of customer	Does not support or relate to customer organisation mission or goals
2	Project Fit to Provider Organisation	Directly supports provider organisation mission and/or goals	Indirectly impacts one or more goals of provider	Does not support or relate to provider organisation mission or goals
3	Customer Perception	Customer expects this organisation to provide this project	Organisation is working on project in area not expected by customer	Project is mismatch with prior products or services of this organisation
4	Work Flow	Little or no change to work flow	Will change come aspect or have small affect on work flow(?)	Significantly changes the work flow or method of organisation
	Program Management (if project is part of a program)			
5	Goals Conflict	Goals of projects within the program are supportive of or complementary to one another	Goals of projects do not conflict, but provide little direct support	Goals of projects are in conflict, either directly or indirectly
6	Resource Conflict	Project within the program share resources without any conflict	Projects within the program schedule resources carefully to avoid conflict	Projects within the program often need the same resources at the same time (or compete for the same budget)
7	Customer Conflict	Multiple customers of the program have common needs	Multiple customers of the program have different needs, but do not conflict	Multiple customers of the program are trying to drive it in very different directions
8	Leadership	Program has active program manager who co-ordinates projects	Program has person or team responsible for program, but unable to spend enough time to lead effectively	Program has no leader, or program manager concept is not in use

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
9	Program Manager Experience	Program manager has deep experience in the domain	Program manager has some experience in domain, is able to leverage subject matter experts	Program manager is new to the domain
10	Definition of the Program	Program is well-defined, with a scope that is manageable by this organisation	Program is well-defined, but unlikely to be handled by this organisation	Program is not well-defined or carries conflicting objectives in the scope
	Decision Drivers			
11	Political Influences	No particular politically-driven choices being made	Project has several politically motivated decisions, such as using a vendor selected for political reasons, rather than qualifications	Project has a variety of political influences or most decisions are made behind closed doors
12	Convenient Date	Date for delivery has been set by reasonable project commitment process	Date is partially being driven by need to meet marketing demo, trade show, or other mandate not related to technical estimate	Date is being driven totally by need to meet marketing demo, trade show, or other mandate; little consideration of project team estimates
13	Use of Attractive Technology	Technology selected has been in use for some time	Project is being done in a suboptimal way, to leverage the purchase or development of new technology	Project is being done as a way to show a new technology or as an excuse to bring a new technology into the organisation
14	Short-term Solution	Project meets short-term need without serious compromise to long-term outlook	Project is focused on short-term solution to a problem, with little understanding of what is needed in the long term	Project team has been explicitly directed to ignore the long-term outlook and focus on completing the short-term deliverable

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
15	Organisation Stability	Little or no change in management or structure expected	Some management change or reorganisation expected	Management or organisation structure is continually or rapidly changing
16	Organisation Roles and Responsibilities	Individuals throughout the organisation understanding their own roles and responsibilities and those of others	Individuals understand their own roles and responsibilities, but are unsure who is responsible for work outside their immediate group	Many in the organisation are unaware of who is responsible for many of the activities of the organisation
17	Policies and Standards	Development policies and standards are defined and carefully followed	Development policies and standards are in place, but are weak or not carefully followed	No policies or standards, or they are ill-defined and unused
18	Management Support	Strongly committed to success of project	Some commitment, not total	Little or no support
19	Executive Involvement	Visible and strong support	Occasional support, provides help on issues when asked some project objectives, measures may be questionable	No visible support; no help on unresolved issues no established project objectives or objectives are not measurable
20	Project Objectives	Verifiable project objectives, reasonable requirements	Occasional support, provides help on issues when asked some project objectives, measures may be questionable	No visible support; no help on unresolved issues no established project objectives or objectives are not measurable
	Customers/Users			
21	User Involvement	Users highly involved with project team, provide significant input	Users play minor roles, moderate impact on system	Minimal or no user involvement; little user input

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
22	User Experience	Users highly experienced in similar projects; have specific ideas of how needs can be met	Users have experience with similar projects and have needs in mind	Users have no previous experience with similar projects; unsure of how needs can be met
23	User Acceptance	Users accept concepts and details of system; process is in place for user approvals	Users accept most of the concepts and details of system; process in place for user approvals	Users do not accept any concepts or design details of system
24	User Training Needs	User training needs considered; training in progress or plan in place	User training needs considered; no training yet or training plan is in development	Requirements not identified or not addressed
25	User Justification	User justification complete, accurate sound	User justification provided, complete with some questions about applicability	No satisfactory justification for system
	Project Characteristics			
26	Project Size	Small, noncomplex, or easily decomposed		
27	Reusable Components	Components available and compatible with approach	Components available, but need some revision	Components identified, need serious modification for use
28	Supplied Components	Components available and directly usable	Components work under most circumstances	Components known to fail in certain cases, likely to be late, or incompatible with parts of approach
29	Budget Size	Sufficient budget allocated	Questionable budget allocated	Doubtful budget is sufficient
30	Budget Constraints	Funds allocated without constraints	Some questions about availability of funds	Allocation in doubt or subject to change without notice
31	Cost Controls	Well established, in place	System in place, weak in areas	System lacking or nonexistent
32	Delivery Commitment	Stable commitment dates	Some uncertain commitments	Unstable, fluctuating commitments

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
33	Development Schedule	Team agrees that schedule is acceptable and can be met	Team finds one phase of the plan to have a schedule that is too aggressive	Team agrees that two or more phases of schedule are unlikely to be met
	Product Content			
34	Requirements Stability	Little or no change expected to approved set (baseline)	Some change expected against approved set	Rapidly changing or no agreed-upon baseline
35	Requirements Completeness and Clarity	All completely specified and clearly written	Some requirements incomplete or unclear	Some requirements only in the head of the customer
36	Testability	Product requirements easy to test, plans underway	Parts of product hard to test, or minimal planning being done	Most of product hard to test, or no test plans being made
37	Design difficulty	Well-defined interfaces; design well understood	Unclear how to design, or aspects of design yet to be decided	Interfaces not well defined or controlled; subject to change
38	Implementation Difficulty	Content is reasonable for this team to implement	Content has elements somewhat for this team to implement	Content has components this team will find very difficult to implement
39	System Dependencies	Clearly defined dependencies of the project and other parts of system	Some elements of the system are well understood and planned; others are not yet comprehended	No clear plan or schedule for how the whole system will come together
	Deployment			
40	Response or other Performance Factors	Readily fits boundaries needed; analysis has been done	Operates occasionally at boundaries	Operates continuously at boundary levels
41	Customer Service Impact	Requires little change to customer service	Requires minor changes to customer service	Requires major changes to customer service approach or offerings

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
42	Data Migration Required	Little or no data to migrate	Much data to migrate, but good descriptions available of structure and use	Much data to migrate; several types of data or no good descriptions of what is where
43	Pilot Approach	Pilot site (or team) available and interested in participating	Pilot needs to be done with several sites (who are willing) or with one who needs much help	Only available or in crisis mode already
	Development Process			
44	Alternative Analysis	Analysis of alternatives complete, all considered, assumptions verifiable	Analysis of alternatives complete, some assumptions questionable or alternatives not fully considered	Analysis not completed, not all alternatives considered, or assumptions faulty
45	Commitment Process	Changes to commitments in scope, content, schedule are reviewed and approved by all involved	Changes to commitments are communicated to all involved	Changes to commitments are made without review or involvement of the team
46	Quality Assurance Approach	QA system established, followed, effective	Procedures established, but not well followed or effective	No QA process or established procedures
47	Development Documentation	Correct and available	Some deficiencies, but available	Nonexistent
48	Use of Defined Development Process	Development process in place, established, effective, followed by team	Process established, but not followed or is ineffective	No formal process used
49	Early Identification of Defects	Peer reviews are incorporate throughout	Peer reviews are used sporadically	Team expects to find all defects with testing
50	Defect Tracking	Defect tracking defined, consistent, effective	Defect tracking process defined, but inconsistently used	No process in place to track defects
51	Change Control of Work Products	Formal change control process in place, followed, effective	Change control process in place, not followed or is ineffective	No change control process used

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
	Development Environment			
52	Physical Facilities	Little or no modification needed	Some modifications needed; some existent	Major modifications needed, or facilities nonexistent
53	Tools Availability	In place, documented validated	Available, validated, some development needed (or minimal documentation)	Invalidated, proprietary or major development needed; no documentation
54	Vendor Support	Complete support at reasonable price and in needed time frame	Adequate support at contracted price, reasonable response time	Little or no support, high cost, and/or poor response time
55	Contract Fit	Contract with customer has good terms, communication with team is good	Contract has some open issues which could interrupt team work efforts	Contract has burdensome document requirements or causes extra work to comply
56	Disaster Recovery	All areas following security guidelines; data backed up; disaster recovery system in place; procedures followed	Some security measures in place; backups done; disaster recovery considered, but procedures lacking or not followed	No security measures in place; backup lacking; disaster recovery not considered
	Project Management (PM)			
57	PM Approach	Product and process planning and monitoring in place	Planning and monitoring need enhancement	Weak or nonexistent planning and monitoring
58	PM Experience	PM very experienced with similar projects	PM has moderate experience or has experience with different types of project	PM has no experience with this type of project or is new to project management

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
59	PM Authority	Has line management or official authority that enables project leadership effectiveness	Is able to influence those elsewhere in the organisation, based on personal relationships	Has little authority from location in the organisation structure and little personal power to influence decision making and resources
60	Support of the PM	Complete support by team and of management	Support by most of team, with some reservations	No visible support; manager in name
	Team Members			
61	Team Member Availability	In place, little turnover expected; few interruptions for fire fighting	Available, some turnover expected; some fire fighting	High turnover, not available, team spends most of time fighting fires
62	Mix of Team Skills	Good mix of disciplines	Some disciplines inadequately represented	Some disciplines not represented at all
63	Team Communication	Clearly communicates goals and status between the team and rest of organisation	Team communicates some of the information some of the time	Rarely communicates clearly within team or to others who need to be informed
64	Application Experience	Extensive experience in team with projects like this	Some experience with similar projects	Little or no experience with similar projects
65	Expertise with Application Area (Domain)	Good background with application domain within development team	Some experience with domain in team or able to call on experts as needed	No expertise in domain in team, no availability of experts
66	Experience with Project Tools	High experience	Average experience	Low experience
67	Experience with Project Process	High experience	Average experience	Low experience
68	Training of Team	Training planning in place, training ongoing	Training for some areas not available or training planned for future	No training plan or training not readily available
69	Team Spirit and Attitude	Strongly committed to success of project; co-operative	Willing to do what it takes to get the job done	Little or no commitment to the project; not a cohesive team

	Risk Factors	Low Risk Cues	Medium Risk Cues	High Risk Cues
70	Team Productivity	All milestones met, deliverables on time, productivity high	Milestones met, some delays in deliverables, productivity acceptable	Productivity low, milestones not met, delays in deliverables
	Technology			
71	Technology Match to Project	Technology planned for project is good match to customers and problem	Some of the planned technology is not well suited to the problem or customer	Selected technology is a poor match to the problem or customer
72	Technology Experience of Project Team	Good level of experience with technology	Some experience with the technology	No experience with the technology
73	Availability of Technology Expertise	Technology experts readily available	Experts available elsewhere in organisation	Will need to acquire help from outside the organisation
74	Maturity of Technology	Technology has been in use in the industry for quite some time	Technology is well understood in the industry	Technology is leading edge, if not "bleeding edge" in nature
	Maintenance and Support			
75	Design Complexity	Easily maintained	Certain aspects difficult to maintain	Extremely difficult to maintain
76	Support Personnel	In place, experienced, sufficient in number	Missing some areas of expertise	Significant discipline or expertise missing
77	Vendor Support	Complete support at reasonable price and in needed time frame	Adequate support at contracted price, reasonable response time	Little or no support, high cost, and/or poor response time
		Total Categories	**14**	
		Total Factors	**77**	

ADDENDUM D

ROLE PLAYERS IN RISK MANAGEMENT

ROLE	TYPE OF INVOLVEMENT
Project Manager (may be Program Manager, if working at that level)	• Drives the risk management process at the start of a project • Participates in risk identification, mitigation, and tracking progress throughout the project • Accepts or rejects the level of risk for the project
Project Team	• Performs the risk management process for this project
Risk Identification Team	• Provides input to the process for identifying risks • Includes representatives of all affected groups involved in the project, as well as any others expected to have insight into risks for this project
Risk Mitigation Team	• Performs actions to reduce the exposure from this risk, focused on either or both the probability and consequence of the risk • May be members of the project team other than affected groups, user, customer, management, and others, depending on the risk item
Process Improvement Team	• Maintains the organisation's risk management process assets, incorporating lessons learned from projects

ADDENDUM E

EXAMPLE OF RISK CHECK LIST

CHECK LIST FOR RISK MANAGEMENT

Category: Customer Risk	
Source of Risk	**Ideas for Risk Reduction**
Meeting customer expectations (no matter how precise the terms of reference, there are typically countless questions of interpretation)	Use customer-mapping technique to organize what you know about the customer organization and its key players.
	Obtain samples of previous work that were considered satisfactory or similar systems and use these as a benchmark to gauge expectations.
	Prepare and present expanded tables of contents and page counts as early as possible.
	Present samples of similar deliverables produced in accordance with the same standards.
	Meet regularly with the Acceptor.
	Use decision request and change request procedures to maintain a record of all related discussions and control all changes relevant to the schedule and cost.
	Maintain a record of all time spent resolving these factors.
	Hold regular Steering Committee meetings.
Managing senior management perceptions	Ensure active involvement of a Steering Committee, so that: • customer management rather than the project team sets the direction for the project, • the continuous, regular involvement of customer management generates commitment, • all issues discussed and resolved increase the user comfort factor.

CHECK LIST FOR RISK MANAGEMENT

Category: Customer Risk	
Source of Risk	**Ideas for Risk Reduction**
Political risk	Assess organizational readiness: • Is senior management committed to the project to ensure that it gets appropriate priority and support? • Do the management and staff perceive that this project will improve the organization and/or the environment in which people work? • Is there a champion with adequate clout who strongly supports the project, to the extent that he/she is willing to fight to have the project succeed? • Are people, computer capacity, money and other resources available to implement the project effectively or are there other competing demands for resources that will receive higher priority? • Do the staff members involved in the project have the necessary skills to implement the project?
	Set up a network to gather intelligence on what the key people are talking about - who speaks to whom, when and why, any issues that may be developing, et cetera
	Use change influences analysis and resistance management techniques to analyse and address driving and opposing forces.
	Prepare specific commitment strategies and plans to obtain political support.
	Establish overwhelming commitment to success at the executive level so that thoughts of failure are not permitted.
	Ensure key opinion leaders are directly involved in the project team.
	Lobby for votes ahead of time to ensure that you know the outcome of key meetings before you go in.
Changing requirements	Define scope up front in measurable terms: • horizontal scope, • vertical scope (which defines the amount of functionality to be automated versus the functionality to be addressed manually), • the limits to be applied to unbounded tasks, • other estimating assumptions, • the acceptance criteria.
	Design for information "hiding" to confine impact of likely changes and minimize their impact on the rest of the system.

CHECK LIST FOR RISK MANAGEMENT

Category: Customer Risk	
Source of Risk	**Ideas for Risk Reduction**
	Plan incremental development, deferring changes to later increments.
Inaccurate or insufficient details in requirements statement	Build in realistic time for confirmation of requirements.
	Include limiting assumptions in contract.
Inability of user to define requirements or ever-expanding scope	Build prototype.
	Limit number of reviews of deliverables.
	Include provision in contract for replacement of Acceptor if scope is undefined by specified milestone. Include provision for termination of contract if scope is undefined by specified milestone.
Gold plating (desire to overautomate)	Establish a budget constraint to focus the effort on where there will be most payback and to force decisions that otherwise would be avoided, including early clarification of major scope issues. With reasonable constraints, a system design is apt to be spare and clean whereas without these, functionality that could be handled on an exception basis is likely to be added into the system design causing the cost and implementation effort to increase dramatically. Typically, even if the system lives through to implementation, only a fraction of such functionality is regularly used. Conduct a cost/benefit analysis. Assign each function a value in an appropriate currency (time, $, m bytes of memory, n microseconds per invocation, et cetera.).
	Design and develop to cost.
Cost is too high	Use Steering Committee to negotiate scope reduction.
	Design/develop to cost.
	Incremental development (versions).
	Scrub requirements and remove unessential.
	Consider software reuse.
	Consider productivity tools.
	Minimize formal deliverables and substitute with working papers.
Pressure for an early completion date	More rigorous up-front planning. Use the WBS for time-reduction analysis. Look for "work-ahead" items that can be started early.

CHECK LIST FOR RISK MANAGEMENT

Category: Customer Risk

Source of Risk	**Ideas for Risk Reduction**
	Design/develop to schedule.
	Develop incrementally (versions).
	Scrub requirements and remove unessential.
	Consider software reuse.
	Consider productivity tools.
	Minimize formal deliverables and substitute with working papers.
	Use a more experienced team.
	Build an excellent infrastructure and SDE well in advance.
	Add schedule management to the formal risk management plan to ensure visibility, and proactively address schedule variances.
	Minimize any changes during the project time frame which may impact the project (for example, changes to project staff, customer policies and procedures).
	Collocate team for maximum productivity.
Lack of user commitment	Obtain executive commitment to provide adequate end-user participation.
	Clearly define specific areas of user responsibility.
	Raise the visibility of customer dependencies at the Steering Committee.
	Appoint a user co-ordinator.
	Set up an Implementation Advisory Group to get a broad range of users involved in acceptance testing, training, user documentation, implementation roll-out, et cetera.
	Develop a plan for ensuring user understanding (for example, user surveys).
	Ensure user awareness of all issues through regular status reports and sign-offs.
	Arrange for user involvement in analysis workshops and prototyping.
	Highlight user responsibility for an Acceptance Test, involving the thorough retesting of all system functions.
	Highlight user sign-offs which put emphasis on the user confirming that they understand or complaining when they don't.
Lack of continuity of key players	Implement key personnel agreements and contractual provisions.

CHECK LIST FOR RISK MANAGEMENT	
Category: Customer Risk	
Source of Risk	**Ideas for Risk Reduction**
Specifying requirements that are difficult or impossible to meet	Staff analysts who are experts in the business area and skilled at negotiating better ways of solving the business problem.
	Use "flying squads" of credible business, application and technology specialists to resolve areas of conflict.
User training and acceptance	Set up an Implementation Advisory Group to get a broad range of users involved in acceptance testing, training, user documentation, implementation roll-out, et cetera.
	Develop a training program and accompanying training plan.
	Install a training infrastructure (for example, help desk, toll-free telephone support).
Achievement of customer's projected return on investment	Reduce exposure by breaking large projects into several smaller ones.
	Sequence projects so that those with tangible benefits are completed first.

CHECKLIST FOR RISK MANAGEMENT

Category: Technical (Product) Risk

Source of Risk	**Ideas for Risk Reduction**
Developing the wrong system (ie, shortfalls in functionality)	Mission analysis: study how the organization performs its mission to enable informed judgement on information requirements.
	User surveys.
	High level of end-user participation.
	Benchmark the "best practices" in equivalent systems elsewhere.
	Build prototype.
	Write user aids early.
	Ensure that a contract is in place which clearly defines scope and deliverables.
Shortfalls in the user interface	User engineering: study how the user works to gain better understanding of the requirements for the user interface.
	Build prototype.
	Write scenarios.
Unknown future changes	Design for information "hiding" to confine impact of likely changes and minimize their impact on the rest of the system.
Compatibility of technical components	Build technical prototype.
Version changes in third-party software over the life of the project	Implement formal risk management techniques and risk tracking/reporting procedures.
Shortfalls in externally supplied components (performance, stability, reliability, robustness, et cetera.)	Benchmarking.
	Inspections.
	Reference checking.
Lack of availability of components	Contingency planning.
Overall system performance (end to end)	Implement formal risk management techniques and risk tracking/reporting procedures.

CHECKLIST FOR RISK MANAGEMENT	
Category: Delivery Risk	
Source of Risk	**Ideas for Risk Reduction**
Personnel shortfalls (people and qualifications)	Staff with top talent.
	Use overqualified staff in critical situations.
	Replace junior team members with more expensive but more productive staff.
	Consider external sources (for example, subcontract).
	Implement key personnel agreements for critical resources.
	Share resources or provide shadow/assistants to minimize the time demand on key resources that are also in demand for other work.
	Provide comprehensive orientation (account, proposal, internal and customer objectives, application, technology, customer, et cetera.).
	Provide additional technical training under the direction of the Technical Architect.
	Bring in special project "start-up" teams to get the team up and running.
Unrealistic project plan (schedules and budget)	Have independent estimators prepare detailed task-based estimates and apply sanity checks.
	Use experience with sample programs (for example, program models) to validate proposed productivity rates.
	Ensure that the estimates are "owned" by the people who will be responsible to deliver to them.
	Design/develop to cost.
	Price by phase, not whole project.
	Incremental development.
	Software reuse.
	Requirements scrubbing.
	Assume risk in starting early.
Project Management	Consider nature of customer in estimating amount of project management time required.
	Implement the project management techniques in the knowledge base.
	Use overqualified Project Manager in critical situations.

CHECKLIST FOR RISK MANAGEMENT

Category: Delivery Risk	
Source of Risk	**Ideas for Risk Reduction**
	Ensure that resolution of all issues and problems are assigned to individuals and documented in Decision Requests, Information Requests, et cetera.
Customer Management	Implement basic techniques such as Steering Committee, status reporting, CR, DR and IR procedures, as defined in the knowledge base.
	Implement activity assignment and progress tracking for customer responsibilities.
	Raise the visibility of customer dependencies at the Steering Committee (have these routinely reviewed).
	Implement formal risk management techniques and risk tracking/reporting procedures.
	Implement formal problem resolution procedures.
Problems with the Acceptor role (no Acceptor identified, inappropriate Acceptor, or multiple Acceptors)	Work with the customer executive to identify an appropriate Acceptor.
	Increase the visibility of the Project Organization Chart (the "H" format) with the Project Manager and Acceptor and make sure the communication channels are clearly identified.
Committed team	Ensure personal and project objectives have been reconciled.
	Ensure that project management fundamentals have been applied (project model, visibility, accountability and confidence).
	Ensure that the cycle of delegate, witness commitment, and monitor commitment is adhered to.
	Individual weekly review of days ahead/behind schedule with each team member.
	Weekly team meetings, as appropriate, to facilitate team communication, develop team spirit, and allow issues to be discussed at the team level on a scheduled basis rather than in interrupt mode.
	Provide productivity tools.
	Focus on team member chemistry.
	Motivate for performance.
	Rotate through project roles, where appropriate, to increase team member responsibilities and provide career development opportunities.

CHECKLIST FOR RISK MANAGEMENT	
Category: Delivery Risk	
Source of Risk	**Ideas for Risk Reduction**
	Coach poor performers.
	Replace poor performers if necessary.
New/unknown technology	Consider external sources (for example, subcontract).
	Provide for training.
Subcontractor capability	Prequalify subcontractors using interviews and formal assessment methodology (for example, SEI Assessment Methodology from Carnegie Mellon University).
	Conduct reference checks.
	Require Competitive Construction of Prototype.
	Conduct preaward audit.
	Check references (and personal commitment level).
	Substitution clause in contract with repayment for time lost.
	Specify conditions and remedy in event of poor performance.
	Plan for early delivery and include contingency plans or if delivery is missed.
Subcontractor ability to deliver as planned	Ensure delivery schedule is included in subcontract.
	Ensure that subcontractor's and prime contractor's delivery schedules coincide.
	Base payment on appropriate milestones.
	Use holdbacks.
	Obtain authorisation to be responsible for the formal performance reviews of the individuals concerned for their work on the project.
Customer ability to meet its delivery commitments	Specify conditions and remedy in event of poor performance.
	Plan for early delivery and include contingency plans if delivery is missed.
	Obtain authority to be responsible for the formal performance reviews of the individuals concerned for their work on the project.
	Routinely raise the visibility of customer performance to plan at the Steering Committee meeting.
Phase gaps	Include in contract negotiations.

CHECKLIST FOR RISK MANAGEMENT

Category: Delivery Risk

Source of Risk	**Ideas for Risk Reduction**
Acceptance delays	Use basic techniques such as Steering Committee, status reporting, CR, DR and IR procedures, to ensure visibility.
Decision delays	Implement basic techniques such as Steering Committee, status reporting, CR, DR and IR procedures, to ensure visibility.
Uncontrolled meeting time	Establish a meeting protocol ahead of time, for example: • effort will be made to limit the number of meetings and minimize the number of attendees at all meetings, • all scheduled meetings will require a specific agenda of matters for discussion to be prepared and distributed in advance, • duration of meeting will be stated in advance and respected, • all scheduled meetings will result in a brief summary of matters resolved, decisions and action plans resulting.
External factors (for example, strike at customer facilities)	Contingency planning.
	Contractual protection.

ADDENDUM F

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