



---

## Risk Estimation From Technology Project Failure

---

Malcolm Bronte-Stewart

School of Computing, University of West of Scotland, Paisley, PA1 2BE  
E-mail: [bron-ci0@paisley.ac.uk](mailto:bron-ci0@paisley.ac.uk)

**Abstract:** Surveys, research and government reports show that IT projects tend to go wrong and that developers, and those in charge, continue to underestimate risk. The National Audit Office reported in March 2009 that plans for a multi-million pound central database known as C-NOMIS failed because of poor management. The report states that plans were optimistic, technical complexities were significantly underestimated, budget monitoring was absent, financial accountability was unclear, roles and responsibilities were blurred and the project's main aim was not met. There is a long history of these technology project failures yet the main causes of failure are well known. This paper considers the costs of failure, compares views of why IT projects go wrong, looks at some examples of IT project failure and presents a three phase technique for estimating an IT project's risks before too much effort and money is spent.

**Keywords:** technology project; success; failure; risk analysis; risk estimation; IT systems

---

### 1 Introduction

IT projects have a bad reputation for going over budget and schedule, not realising expectations and for providing poor return on investment (Clegg et al, 1997; Keil et al, 1998; Fielding, 2002; The Register, 2002; Jaques, 2004; McManus and Wood-Harper, 2008). Surveys and reports on the acceptability of new IT systems seem to highlight constantly the same problems and probable causes of failure yet businesses, large and small, continue to make mistakes when attempting to improve information systems and often invest in inappropriate or unworkable changes without proper consideration of the likely risks.

This paper aims to explain the reasoning behind the development of a technique for evaluating potential threats to the success of an IT project at an early stage. To begin with we look at the scale of the problem by reviewing evidence of the remarkable costs and frequency of project failure. Then we consider the findings of five important reports on IT project failure and capture the factors or pointers that, according to these reports, most influence success in a table. Next the paper explores concepts of success and failure before commenting on some of the wider issues that caused problems in a variety of case studies. There follows a section that discusses approaches to risk management which leads to an explanation of a technique that can help with the estimation of IT project risk. Links between this technique and the assessment of the causes of failure are explained. Finally some conclusions are drawn.

### 2 The Costs of IT Project Failure

Planning and organising projects, establishing requirements for change, selecting and purchasing suitable software and hardware and designing effective web sites are important business decisions yet firms often do not take adequate precautions or advice before spending large sums of money on what turn out to be inappropriate, unwanted or badly implemented IT systems. Many large IT systems

contracts are in dispute or have been suspended. Some figures and examples may help to illustrate the nature and scale of the situation and its persistence:

- Research conducted by KPMG among 134 listed companies in the UK, USA, Africa, Australia and Europe showed that over half of them admitted to suffering a failed IT project in the past 12 months costing each of them as much as £8M. (Fielding, 2002). The survey also suggested that the reason such projects fail is poor communication between company managers and those who build and manage new IT infrastructure, poor management, that only 23% of the organisations' personnel were certified by the Project Management Institute and poor planning, that 81% used what KPMG deemed a "home-grown" methodology. (The Register, 2002).
- A study of 50 government projects over 20 years found that those involving technical innovation and systems development historically ran over budget by up to 200% and over the original contract duration by 54%. This led the Treasury to issue a warning that the public sector is over-optimistic when evaluating IT project costs and timescales. (McCue, 2002).
- An Oxford University survey reported that only 16% of IT projects were successful, around 74% were 'challenged' and 10% were abandoned. (Saur and Cuthbertson, 2003).
- In January 2003 "Libra", a new IT system for Magistrates Courts that was to include upgraded infrastructure, office automation facilities, a national casework application and electronic links with other criminal justice agencies, was described by the chairman of the Public Accounts Committee as, "One of the worst IT projects I have ever seen." (Computer Weekly, 2003). The original PFI contract for £184m over 10.5 years was awarded in 1998 but by May 2000 the price had been revised to £319m over 14.5 years. The deal subsequently collapsed and was renegotiated at a price, for the infrastructure alone, of £232m. The total system would take 8.5 years to develop and cost around £400m. The department was forced to procure new contracts with other suppliers for software and systems integration.
- A project to replace the British Army, Navy and Air Force inventory systems with a single system was brought to a halt after £130m had been spent. Hardware worth just over £12m was used elsewhere but the remaining £118m was written off. (Fortune and Peters, 2005).
- According to a report from the Royal Academy of Engineering and the British Computer Society billions of pounds are wasted every year on badly managed IT system deployments. "The UK public sector alone spent an estimated £12.4 bn. on software in the past year and the overall spend on IT is projected to be 22.6bn". The study suggests that only about 16% of projects can be considered successful and even conservative estimates put the costs of failures into the tens of billions of pounds across the EU." (Jaques, 2004).
- In July 2005 MPs in the parliamentary intelligence and security committee stated that SCOPE, a communication system linking UK intelligence agencies, was going to be have less capability, take 3 years longer and cost 50% more than original estimates (BBC 2005).
- The Commons Public Accounts Committee (PAC) reported that nearly a third of high-risk government projects are not using the Gateway review process, introduced in 2000, to check properly for potential budget and system failures. Chairman of the PAC, Edward Leith, said that "far too often major IT enabled projects in government departments are late, well over budget, or do not work at all – an enormous waste of taxpayers' money." (Telegraph 2005)
- The average organisation spends around 20% of their total budget on IT procurement, maintenance, operation and development and approximately \$500 billion is wasted worldwide each year on IT purchases that fail to reach their objectives (Feld and Stoddard, 2004).
- The cost of project failure across the European Union was €142 billion in 2004. (McManus and Wood-Harper, 2008).
- An attempt to introduce an integrated offender management computer system for the prison and probation services, that was abandoned after forecast project costs had trebled to £155m, was described as "*a masterclass in sloppy project management*" by the chairman of the Commons public accounts committee, Edward Leigh. He went on to say "*This committee hears of troubled government projects all too frequently but the litany of failings in this case are in a class of their own. All of this mess could have been avoided.*" A National Audit Office investigation into the project, known as C-nomis, shows that it was hampered by poor management, leading to a three-year delay, soaring costs, and reductions in scope and benefits. (The Guardian, 2009)

In summary it is apparent that a lot of time and money seems to be spent on IT support and development but, one way or another, a great deal is wasted. The costs of failure are not limited to narrow considerations of budget and schedule. The more IT projects are seen to go wrong the more the public learns to expect problems and delays, the more developers may think that much of their work is

likely to a waste of effort, the more those holding the purse strings may view any IT project as a worry and probably a poor return on investment. IT staff can become cynical, lose goodwill and not accept or follow the advice of managers. For all these reasons we should be looking for ways to reduce the incidence and effects of failure.

### **3 Reports on the Causes of IT Project Failure**

Much has been written about the extent and causes of IS/IT project failure and numerous studies have discussed a range of recognised risk factors including those concerning: project leadership and management, organisational culture and structure, commitment and patterns of belief, user involvement and training, developer expertise, technology planning, scope and objectives setting, estimation and choice/use of methodology, (McFarlan, 1981; Block, 1983; Corder 1989; Boehm, 1991; Barki et al, 1993; Willcocks and Margetts, 1994; Stowell and West, 1994; Keil et al, 1998; Sumner, 2000; Bronte-Stewart, 2001; The Register, 2002; Cusing, 2002; POST, 2003; BCS, 2004, The Standish Group, 2006; NAO, 2006; Sauer, Gemino and Reich, 2007; ICACA, 2008; Verner et al., 2008; Hashmi, 2009).

It may be helpful to review the findings of some published investigations into IT project success and failure in more detail. These five reports have been selected because they are based on substantial research involving surveys and analysis of experiences of many organisations and IT projects. Another aspect they share is that they derive and publish lists of what appear to be the most important factors affecting IT project success/failure.

#### **3.1 OASIG**

The OASIG (1996), a DTI-supported special interest group (SIG) concerned with the organisational aspects (OA) of IT headed by Professor Chris Clegg of the University of Sheffield, studied the extent to which investments in IT in the UK were meeting their objectives. They interviewed a group of leading researchers and consultants who between them had over 900 years of professional work in the field, and were drawing on the experiences of over 14,000 organisations. The report to the UK's Economic and Social Research Council published the following disturbing findings on the eventual outcomes of IT projects:

- 80% to 90% do not meet their goals.
- 80% are delivered late and over budget.
- 40% fail or are abandoned.
- Over 60% do not address training and skills requirements sufficiently.
- More than 75% do not integrate business and technological objectives properly.

The report went on to suggest some of the main reasons why IT projects seem to fail:

- Management agenda is too limited in that most IT investments are technology led and the main investment motive is only to cut costs. This narrow focus on technical capabilities and efficiency goals means that inadequate attention is given to the human and organisational issues that can determine a project's ultimate success.
- Users do not influence development enough.
- Senior managers do not understand the links between technical and organisational change.
- Project management techniques and IT approaches are too technical.
- Companies fail to organise work or design jobs and roles properly.

The OASIG study found that successful projects were characterised by an integrated technical/organisational/human approach to change, with strategic objectives for change being set and reviewed. The project managers were given responsibility for incorporating human and organisational factors, and worked to detailed implementation plans.

#### **3.2 BCS**

A survey for the British Computer Society, (Taylor 2001), found that only around one in eight projects (130 out of 1,027 projects or 13%) were successful (i.e. delivered on time, cost and to specification). For development projects the figure was even worse with less than 1% succeeding. The survey found that poor management of the requirements and scope of a project were the most common reasons for failure. Risk, communication and the change process were also badly managed.

#### **3.3 Standish Group**

According to an often-cited report called “CHAOS” from The Standish Group International, surveying 365 companies found that of the 3,682 technical projects (involving change and information technology) undertaken (across a range of industries) only 12% to 16% were fully successful. These few successful projects were on time, within budget, and delivered with the full complement of promised requirements. Nearly 53% were “challenged”, had cost overruns and impaired functionality or were completed unsuccessfully. Of these, the average cost overrun was 189%. The average time overrun was 222%. Overall, only 61% of their required features were delivered. The balance, the remaining 31%, were cancelled at some point in the development cycle. Their research aimed to discover the main reasons why IT projects fail. The following table shows some of the results of this survey listing on the left the top ten project reasons why projects succeed and on the right the top ten reasons why projects are impaired and ultimately cancelled. It is clear there are many similarities between these lists and that little has changed since the original survey was carried out.

**Table 1:** Some of the results of The Standish Group survey (1995), The CHAOS report.

Rank	Project Success Factors	% of Responses	Project Impaired Factors	% of Responses
1	User involvement	15.9	Incomplete requirements	13.1
2	Executive management support	13.9	Lack of user involvement	12.4
3	Clear statement of requirements	13.0	Lack of resources	10.6
4	Proper planning	9.6	Unrealistic expectations	9.9
5	Realistic expectations	8.2	Lack of executive support	9.3
6	Smaller project milestones	7.7	Changing requirements and specifications	8.7
7	Competent staff	7.2	Lack of planning	8.1
8	Ownership	5.3	Didn't need it any longer	7.5
9	Clear vision and objectives	2.9	Lack of IT management	6.2
10	Hardworking, focussed staff	2.4	Technology illiteracy	4.3
	Other	13.9	Other	9.9

### 3.4 Schmidt et al. (2001)

This group of researchers conducted three simultaneous surveys of experienced project managers in three different settings: Hong Kong, Finland and the United States. The three panels of experts identified an initial list of 53 IT project risk factors. This list was ranked and pared down to a reduced set of 17, which are shown below:

- Lack of top management commitment to the project
- Misunderstanding the user requirements
- Not managing change properly
- Failure to gain user commitment
- Lack of adequate user involvement
- Failure to manage end-user expectations
- Unclear / misunderstood scope and objectives
- Changing scope and objectives
- Number of organisational units involved
- Lack of effective project management skills
- Lack of effective project management methodology
- Lack of required knowledge / skills in the project personnel
- Insufficient / inappropriate staffing
- Improper definitions of roles and responsibilities
- Lack of frozen requirements
- Introduction of new technology
- Conflict between user departments.

Keil et al (2002) criticise this study because they say it only considers the views of project managers who are usually drawn from the ranks of the information system department and are likely to represent the interests of developers not users. They carry out a separate Delphi study of user views which they compare to the results of the project managers' responses. Although the rankings of the various factors are different their findings show interesting similarities with the views of project managers.

### 3.5 UK Government Reports

Successive UK governments have recognised the problems of successfully developing IT systems. Over the past few years high profile IT difficulties have affected the Child Support Agency, Passport

Office, Criminal Records Bureau, Inland Revenue, National Air Traffic Services and the Department for work and Pensions, among others.

In 2002, the Public Accounts Committee reported that the government had 100 major IT projects underway, with a total value of £10 billion, (Public Accounts Committee HC845, 2002). The Spending Review of 2002 allocated around £6 billion over three years to government electronic service delivery, (Office of the e-envoy, 2002), however Computing Magazine (2003) calculated that the cost of cancelled or over-budget government IT projects over the previous 6 years had been greater than £1.5 billion.

E-government developments should be managed better than this. Plans for reforming public services depend on many large new IT systems. The government spends over £14bn a year on computer systems and services, the highest figure in Europe and double the sum spent in 1999. (Prospect, 2005) There are many examples of failed IT projects in other countries, indeed the record cost-overrun in a civil IT project is probably the US internal revenue service's \$30bn tax modernisation system in the mid 1990s.

The select committee on public accounts report entitled "Improving the delivery of Government IT projects" (1999), draws out lessons from more than 25 cases where badly implemented IT systems have resulted in delay, confusion and inconvenience for British citizens and, in many cases, poor value for money for taxpayers. The report suggests that Government departments must have effective IT systems in place and working so that they can respond to the needs and expectations of citizens and also allow citizens to fulfil their obligations to the state quickly and properly. It claims however that, for more than 2 decades, implementing IT systems successfully has proved difficult. The importance of the timely delivery of IT projects and the effects delays in implementation can have were demonstrated clearly by the long queues for passports and by the fact that many thousands of benefit recipients did not receive their full entitlement. The key conclusions of the report were:

- 1 Failure to deliver the required IT systems can have a profound effect upon an organisation's ability to provide services to its customers. Decisions on IT are therefore business decisions, not technical ones, and should involve the commitment of senior management.
- 2 Although projects grow from identified business needs, what seems a clear objective at the start can become blurred and confused as the project progresses. End users must be identified before the project begins so that their needs are taken into account throughout.
- 3 Large and complex projects are particularly risky endeavours. Managers should give careful consideration to whether a project is too ambitious to undertake in one go, especially if it connects with the operations of other parties.
- 4 Skilled project managers are essential for ensuring that IT projects are delivered to time and budget. Successful implementation of IT systems also depends on imagination, well-conceived risk management and sound methodologies.
- 5 A high degree of professionalism in the definition, negotiation and management of IT contracts is needed. With large sums of money at stake any lack of clarity, or debateable interpretation, in a contract can lead to expensive misunderstandings, that may even have to be resolved in court.
- 6 It is important that staff know how to make full and proper use of IT systems otherwise the anticipated business benefits will not be realised. Training can take up considerable resources as it must address the needs of both the users and those who will operate and maintain the systems.
- 7 In addition to planning and managing projects positively, departments should have contingency plans in place to provide adequate levels of service in the event of the project failing.
- 8 There should be a post implementation review designed to establish the extent to which a project achieved its anticipated benefits. The review may study whether the project met its objectives, user expectations and technical requirements.

### **3.6 NAO / OGC**

Based on their experience of major project audits the National Audit Office and the Office of Government Commerce have compiled, reviewed and updated a list of common causes of project failure, (NAO/OGC, 2005).

- Lack of clear link between the project and the organisation’s key strategic priorities, including agreed measures of success.
- Lack of clear senior management and Ministerial ownership and leadership.
- Lack of effective engagement with stakeholders.
- Lack of skills and proven approach to project management and risk management.
- Too little attention to breaking development and implementation into manageable steps.
- Evaluation of proposals driven by initial price rather than long-term value for money (especially securing delivery of business benefits).
- Lack of understanding of and contact with the supply industry at senior levels in the organisation.
- Lack of effective project team integration between clients, the supplier team and the supply chain.

The Parliamentary Office of Science and Technology (POST, 2003) highlight other issues. These include several circumstances peculiar to Government sponsored projects:

- Public sector projects usually attract more media attention and are more open to scrutiny than private sector projects.
- Policy changes rapidly in the public sector and legislation may require last minute changes.
- Government personnel may not be sufficiently familiar with the fundamental concepts and current developments of IT so are unable to judge if suppliers are overselling to them.
- Advances in technology may occur so quickly that large projects can be obsolete before they are delivered yet state-of-the-art solutions always carry greater risk
- User requirements are often unclear at the start and can change at any stage in the project’s lifecycle.
- Many Government IT projects are large and extremely complex with millions of lines of code and so it is often impossible to guess how big a job will be before it starts.
- It is difficult for non-technical management to ascertain the quality or completeness of software during the development process.

**Table 2:** Differences between IT projects in public and private sectors (Intellect, 2000)

<b>Public Sector Projects</b>	<b>Successful Private Sector projects</b>
Have multiple aims, so hard to measure success	Focussed on measurable financial and service outcomes
Generally not in competition with other projects	Business Driven by competition
Highly visible to the public and the media	Often not visible to public or shareholders
Constrained by UK and EU legislation	Less constrained by legislation and regulations
Managed in a risk averse culture	Open to risk taking
Difficult to adapt to change due to scale and complexity	Designed to limit damage when they are in difficulty
Likely to interact with other departments	

The POST report goes on to recognise the importance of outsourcing and negotiating with the suppliers of IT equipment and services: *“Much government IT is now delivered by external suppliers so government needs to be an intelligent client. Departments need a range of skills to scrutinise bids, keep up to date with technology, be realistic about what systems are likely to deliver, understand commercial drivers and actively manage suppliers. ... IT projects should be tied in to overall objectives and not simply seen as about technology. High quality project management skills and good communications are essential so that problems are identified early when they are more easily solved. Involving the people who will use the final service is also critical to define requirements, reduce resistance and provide for training. Breaking projects down into small manageable steps increases the chances of success and makes contingency planning easier.”* This statement demonstrates the importance they give to factors such as user involvement and training, objective setting that is connected to business aims, project management and sensible scoping.

#### **4 Summary of Common Causes of IT project Failure**

Clearly these frequently cited and carefully researched reports have many features and recommendations in common and the following table (Table 3) aims to demonstrate this by summarising and comparing the main reasons given for IT project failure.

**Table 3:** Research reports by a Government select committee (2000), OASIG (1996), National Audit Office (NAO)/Office of Government Commerce (OGC) (2005), Standish Group CHAOS (1995) and Schmidt et al (2001) that identify typical causes of failure/success in IT projects.

Select Committee	OASIG	NAO/OGC	CHAOS (Top Requirements)	Schmidt et al
IT projects are driven by business (not technical) decisions	Many IT investments are seen only as technology led and aimed at cost cutting	Evaluation of proposals driven by initial price rather than long term value, especially securing delivery of business benefits	Clear business objectives and Realistic expectations	Misunderstanding user requirements
Insufficient involvement from users	Users do not influence development enough	Lack of effective engagement with stakeholders	User involvement	Lack of user involvement or commitment
Clear objectives should be set from the start	Need to set and review strategic objectives for change	Lack of clear link between the project and the organisation's key strategic priorities, including agreed measures of success	Clear and firm of requirements	Unclear and changing scope and objectives
Lack of commitment from senior management	Management agenda is often too limited or narrow	Lack of clear senior management ownership and leadership	Executive management support	Lack of top management commitment
Large projects may be overambitious	Inadequate attention is given to human and organisational issues	Too little attention to breaking development and implementation into manageable steps	Minimised scope and smaller project milestones	Number of organisational units involved
Skilled project managers are essential to keep to time and budget and appropriate deliverables	Senior managers do not understand the link between technical and organisational change	Lack of skills and proven approach to project management and risk management	Experienced project managers	Lack of required knowledge and effective project management skills
Success depends on good risk analysis and sound methodologies	Some project management techniques and IT approaches are too technical		Proper planning and formal methodology	Lack of effective project management methodology
Contingency plans should be in place	Must work to detailed implementation plans		Reliable estimates	Not managing change properly
User and operator training must be planned and designed	Failure to organise changes in work and roles properly	Inadequate resources and skills to deliver the total delivery portfolio	Competent, skilled and focussed staff	Inappropriate staffing and ill defined responsibilities
There should be a post-implementation review			Standard software infrastructure	Introduction of new technology
Need professionalism in the definition, negotiation and management of IT contracts		Lack of understanding of , and contact with, the supply industry at senior levels in the organisation	Ownership	

## 5 Success and Failure

So far we have looked at raw statistics and typical or common causes of failure with little attention to the assumptions and complexity that underlie notions of success and failure. The next section looks at views of these concepts.

Projects are often defined as having particular characteristics (APM, 2005; Cotterell and Hughes, 1999). A project is likely to:

- Be a unique set of coordinated activities, a one-off programme,
- Have a few, clear, specific objectives,
- Have a life-cycle, usually categorized into manageable stages,
- Have an identifiable start and end,
- Have defined budget, schedule and performance parameters,
- Require the use of many resources that may also be needed on other projects,
- Need a special team of people.

These tangible characteristics distinguish projects from ordinary, routine operations and they may be used as criteria against which to measure a project's success.

Despite the apparent clarity of these measurable characteristics, defining success or failure for IT projects can be difficult (Oakes, 2006; Standing et al. 2006). For example a project may keep within set budget and time scales yet not reach expectations or fail to provide benefits or be out of date when delivered. On the other hand a project may over-run time and financial constraints due to increases in scope and / or requirements creep but still produce a worthwhile delivered result. Is it unfair to judge these amended projects by the constraints set in the original terms of reference?

Was failure an event or a process – did it become evident that the project was a failure suddenly or over a long period? To what extent was the observed failure caused by optimistic and poorly thought out planning before kick-off, or was its lack of success caused more by the way in which it was managed and carried out. Who is to bear the blame, the planner who set the parameters or the project manager who had to abide by them? Were the stated objectives quite different to what seemed to be the more secret, underlying purpose(s) of the project?

Success and failure may also vary over the life of a project and it is not always obvious when we should make a yes/no assessment. For example, the introduction of a new Passport Agency IT system led to long delays (which cost an estimated £12m including £16,000 spent on umbrellas to shelter those queuing in the rain) in issuing passports in the summer of 1999 yet 4 years later the system was working well with 99.5% of straightforward applications being turned around within 10 days (UK Passport Service Annual Report and Accounts, 2003).

Sauer (1988) explains these difficulties with establishing simple either/or definitions of success and failure quite well when he comments that *“Some systems never work. Some are never made operational because they will be unacceptable to the user. Some work but come in cripplingly over budget, very late or both. Others are pared down while still others are literally forced into place in their host organisation, despite their being either inappropriate or unacceptable. Some perform to specification but turn out to be so inflexible that maintenance and enhancement assume nightmarish proportions. Others are thought to work, but turn out not to.”* It is possible that the statistics reviewed earlier in this paper may be misleading as it could be argued that they do not show enough detail of the circumstances which led to the projects being labelled failures for the reader to make informed assessments about the nature or extent of failure.

Furthermore it may be almost impossible to find agreement about whether a project succeeded or failed. When trying to make sense of the ambiguity of notions of success and failure it may be useful to view them as being subjective judgements. Beauty is in the eye of the beholder. For example, Naughton and Peters (1976) discuss system failures as concerning human perception and identification, and thereby acknowledge that one person's failure might be another's success. The notion that a project failed may mean that it did not meet certain people's objectives or that it produced what were seen by some as undesirable outputs. Project instigators may wish to think of their “baby” as a success despite negative comments by others. Vickers (1981) suggests *“A human system fails if it does not succeed in doing what it was designed to do; or if it succeeds but leaves everyone wishing it had never tried.”* The impact and consequences of the project may not be fully appreciated before implementation.

Lyytinen and Hirschheim (1987) view IS failures as problems that stakeholders perceive. This sounds like a straightforward policy until one asks how bad are the problems and who are the stakeholders they refer to? If ‘problems’ include what many would call minor niggles and ‘stakeholders’ includes all those who might have an interest in the project it is likely that few projects will succeed. Robinson (1994) points out that a project's failure or success is defined in relation to a particular group with its own roles, goals, interests and expectations which are assessed in the context of an organization and its political and social environment.

Peterson and Kim (2000) suggest that IS project success can be classified by four views (the system, the users, the organization and the strategic view) of short-term and long-term objectives, (Table 4).

**Table 4:** a classification of short and long-term objectives.

	<b>System</b>	<b>User</b>	<b>Organisational</b>	<b>Strategic</b>
<b>Short-term Objectives</b>	Reliable (bug-free) system	Satisfying user needs	Improving the effectiveness of business operations	Improving customer service
<b>Long-term Objectives</b>	Easily maintainable system	Improving productivity of managers	Generating operational benefits	Enabling cooperative partnership

Ewusi-Mensah (1997) states that IS projects are unique in that they are conceptual in nature and require the intense collaboration of several different groups of stakeholders including IS staff, users and management. IS projects are usually undertaken in teams and therefore subject to the vagaries of group dynamics, interactions, coordination and communication. The diverse backgrounds and training of the various team members and other people associated with the project make the ability to communicate and coordinate the activities of the group extremely important.

Roger Elvin, (Senior 2003) research fellow in Information Systems at Cranfield School of Management, takes this further when he points out some of the incongruities, compromises and awkward balances inherent in information system projects: *“The management of IS projects is a difficult and complex task and there are no magic bullet solutions. IS projects are intrinsically uncertain. The management complexity arises from the necessity to deal simultaneously with several tensions:*

- *Innovation versus risk*
- *Learning versus control*
- *The need for organisational change to deliver business benefit versus stakeholder resistance to change*
- *Multiple stakeholder perceptions of the purpose of the project*
- *The need to deliver value to the organisation versus managing effectively to satisfy time, quality and cost objectives*
- *Managing detail and the big picture”.*

Jim Norton, senior policy advisor on eBusiness and eGovernment at the Institute of Directors and an external member of POST, comments rather provocatively that *“There is no such thing as a computer project. There are business change projects that involve IT. For projects to be successful, they must consider the people dimension, explaining what is entailed, motivating and training staff and making them aware that productivity will initially fall with the move from the old to the new way of doing things.”* (Kelly, 2003).

In a similar vein Julie Senior (2003) quotes advice from Colin Saunders, the IT director of Warburtons: *“There is no such thing as an IT project and therefore no need for an IT department. Successful projects are about benefits-realisation and that requires business ownership. Too many senior end-user managers abdicate ownership and expect the IT department to deliver business process change, financial benefits and service improvements. Don’t get me wrong. I am not advocating the abolition of the tasks and jobs performed by the personnel in IT. However there must be a better organisational model. Practically all business improvement is enabled by technology. We help make businesses better. But we are neither the creators nor the consumers of information and we do not perform business processes. Hence there is no such thing as an IT system. When we deliver an IT system what we are saying is that the business is improving itself and technology has enabled that improvement. Responsibility for the improvement and realising the benefits of the investment lie with the business.”*

From the above it seems that arriving at simple and agreeable definitions about objectives, timescales and measurements of what constitute success and failure in IT projects is problematic. On the other hand there appears to be wide recognition that IT projects are often complex, involving many viewpoints and agendas, and this can make such projects difficult to predict or evaluate.

## 6 Examples of failed business IT projects.

Having reviewed some extensive surveys, major reports and general comments on IT projects and gleaned a better understanding of the nature of and commonest reasons for failure it may be helpful to look at some other factors that can cause problems.

Many of the IT projects that were investigated in the reports mentioned earlier included substantial software development however organisations are now buying packaged IT systems more often than building bespoke software from scratch and getting IT procurement choices wrong can mean living with expensive mistakes for years ([http://www.electrum.co.uk/wwword/demo/national\\_software\\_strategy/the\\_strategic\\_options/](http://www.electrum.co.uk/wwword/demo/national_software_strategy/the_strategic_options/)). There are all too many examples of businesses being sold IT systems that do not deliver what was expected of them. Although they may not realise it decision makers are frequently slapdash in their approach to working out what is needed, they are not careful in their selection of IT systems and/or the suppliers of those systems, they do not realise the importance of effective training and change management and they fail to take precautions in case things go wrong ([www.it-cortex.com/stat\\_failure\\_rate.htm](http://www.it-cortex.com/stat_failure_rate.htm)).

Computerization does not automatically increase productivity, but it is an essential component of a system of organizational changes which can. As the impacts of IT systems become greater and more pervasive, it is increasingly important to consider these organizational changes as an integral part of the computerization process. (Brynjolfsson and Hitt, 1998). Allowing for and managing the power, politics and organisational conflict inherent in IT system change is increasingly recognised as being of critical importance to successful information systems development (Warne, 2003).

One way to learn more about these other factors is to study the background and circumstances of some specific examples of what were reported as abandoned or unsuccessful IT system projects to gain a deeper insight into a wider range of aspects that threaten success. These case studies summarise the context, problems and impact of failure for each example.

a) The government's spending watchdog, the National Audit Office, disclosed that a computer system set up to support Britain's training programme for the unemployed had to be scrapped at a cost of £48 million. The NAO said that a series of blunders by ministers and top civil servants led to the commissioning of a national computer "Field System" which plunged the accounts, programmes and collection of information by the 82 Training and Enterprise Councils (TECs) into chaos. The report states that the project was rushed into without a proper examination, or appreciation, of the risks involved. Developmental errors uncovered by the report include weaknesses in staffing and management, inadequate support and poorly controlled use of consultants. Problems were compounded by poor quality software (7000 software bugs and requests for changes were recorded) and insufficiently trained staff. The highly critical report says the "particularly ambitious and technically complex project" was managed by staff "most of whom did not possess the necessary skills and experience" to run it. More than 200 consultants were called in eventually, but the ministry broke government rules by:

- i) employing firms without going to competitive tender,
- ii) allowing firms to work before they signed contracts, and
- iii) extending contracts without renegotiating them.

b) Essex Police Force awarded a £1.5 million contract to GEC-Marconi before it had finished the user requirements specification for a crime handling and police intelligence system. Delivery of the system was to be within 2 years, however, because the specification was put out to tender before it was complete and had subsequently been added to and amended substantially, not a single line of program code had been written by then.

c) Taurus - the multimillion-pound IT project to automate the London Stock Exchange (LSE) share trading operations was abandonment after six years work by up to 350 technicians. Taurus is one of the most referred to failures in the IT/IS world. It was said to have cost between £75m and £400m before it was abandoned. Media coverage about the collapse of the project pointed to the following causes:

- Political - There was a struggle between organisations, developers and the LSE to maintain power over the system because, if implemented successfully, it would revolutionise the status of the LSE world-wide and everyone wanted to be boss.

- Ambitious time-scale - The project plan was not based upon a realistic estimate of time and resources. The project was unprecedented. It was one of the largest IT projects to be carried out in Europe, yet there was pressure to complete quickly rather than properly.
- Escalation/Requirements Creep - Was the system being built for the LSE, the listed companies, the brokers, the money makers...? This debate led to Taurus being a complex combination of requirements – attempting to please everyone. As more and more groups got involved with the project, the requirements began to escalate, along with the costs.
- Responsibility - There were so many people involved or to benefit from the project that it became unclear who was responsible for managing the project.
- Poorly defined requirements - The requirements that were put forward were not discussed sufficiently or analysed properly. No-one understood what was required of the system.
- Constant demands for change - As the system was being developed, there were continual changes in specification. These changes often meant that parts of the system had to be scrapped and then replaced.
- Rhetoric – major problems were ignored when they began to surface as no-one wanted to question progress or authority.
- Complex Security Arrangements - A high level of security was required of the system and this added to the complexity of the design.

d) Avon County Council implemented a new computer program to pay staff wages without sufficient testing. Problems became apparent in a small way when the new system paid a caretaker £75 an hour instead of 75 pence. Then the new system didn't pay canteen workers at all for 7 weeks. Next it paid a janitor £2,600 for a week's work. A deputy headmistress received her year's annual salary once a month, heads of department earned less than their assistants and some people had more tax deducted in a week than they earned all year. Within months 280 council employees were out on strike.

e) British Gas were “submerged in a deluge of complaints” when they sent out incorrect bills and disconnection threats. Thousands of reminders were posted before the first bill had been sent. Customers paying by direct debit found huge sums of money had been removed from their bank accounts. For example a doctor from Middlesex had £3,796 deducted from his account even though he had been assured that the real figure was £39. There were even some reports that people had been disconnected despite paying their bills. The rash of errors provoked a huge and angry reaction from consumers. A Gas Consumer Council spokesman reported “British Gas has put too much faith in untried systems and has installed them too quickly, with inadequate backup from too few staff and at the wrong time of year”.

f) Newspaper articles about the rather unsuccessful attempt to computerise the London Ambulance System said it had ‘put lives at risk’! The original estimate for the work was £1.25million. The project was eventually abandoned after £7.5million had been spent. The main findings of the official report written after the investigation on the reasons why the new system had failed were that:

- The procurement team was inexperienced
- Staff mistrusted and opposed the project
- NHS management and unions were at loggerheads
- The project's timetable was over-ambitious
- Price was put before quality
- Systems and requirements analysis was superficial
- Local, tacit and heuristic knowledge was ignored
- The software was incomplete and not properly tested
- The emergency back-up system was untested
- Training was inconsistent and incomplete
- A worrying report by Andersen Consulting, that pointed to problems with the management of the project, had been suppressed
- Management failed to identify, control and solve problems during the project
- Users “did things wrong”
- “...a faulty system implemented with undue haste, by a management determined to impose its will...”

g) The replacement of one of Scotland's main police computer systems was 2 years late and £3m over budget ministers admitted in April 2005. A consultants report said too little attention had been paid to

what the new system would do and recommended bringing in outside help costing £3.3m. Stewart Maxwell, MSP, called the project “ a complete disaster. With no budget set and no one in charge, five years into the project the whole thing has not surprisingly collapsed”.

h) West Midlands Regional Health Authority wasted £4m on an IT system it never used. Auditors described the development as speculative and unrealistic and said the contract was awarded without competitive tender, potential users were not consulted and changes were made to the specification without proper approval.

i) Consultants were called in after it was found that the working party set up to decide the IT strategy for Watford Council had no priorities and “gave approval to those who shouted loudest and longest”, users had been purchasing incompatible equipment piecemeal, without reference to any standards.

The frequency, scale, repercussions and fame of these problems seem to point to the need for a more reliable approach to predicting, reducing and avoiding as many problems as possible in projects involving changes to business IT systems, information systems consultancy and procurement.

## 7 Project Risk Analysis

It is important to estimate a project's risk and feasibility early in the lifecycle yet it appears that risks are insufficiently understood and that risk analysis is not done properly. Risk may be thought of as the chance of a negative outcome. Risk analysis can be defined as the business of identifying and evaluating the threats, options and possible outcomes of decisions. Wiegers (1998) describes project risk as a problem which has not yet happened but which could cause some loss or threaten the success of the project if it did. These descriptions help to illustrate the breadth and vagueness of notions of risk.

Risk assessment usually depends upon many assumptions, variables and factors including individual experience and attitude. (Ould,1999; Waring and Glendon, 1998; Goodwin and Wright, 2004) We are likely to try to assess the potential profit and loss of choices before taking a gamble. “*Fools rush in where angels fear to tread*” but, conversely, “*nothing ventured, nothing gained*”. Estimating the significance of risk may involve guessing the expected result of the conditional probability of an event occurring multiplied by the assumption of the consequences of the event if it was to occur. In other words, risk can be analysed in terms of the understanding of a ratio of: a possibility of gain accompanied, opposed or balanced by some threat of loss.  $R=I*C$  [*Risk* = magnitude of potential disaster or benefit (*Impact*) multiplied by the possibility of it happening (*Chance*)]. Reducing complexity to a simple formula may seem reassuring however risk assessment is highly subjective and experiential and it is usually difficult to guess values for these related possibilities. A great deal depends on various attitudes, values, perceptions and feelings about important influences and current conditions, including aspects of politics and culture, as well as the analyst's or analysts' background, training, psychology and judgement.

For example, we may ask who determined which risks should be taken seriously and to what extent are the degrees of danger of possible threats to the project perceived or imagined? An analyst may not recognise, or anticipate, or comprehend, the consequences of many risky situations. They may not come up with or consider a comprehensive and representative set of risk factors. They may easily misconstrue the chance or magnitude of loss or opportunity. There may be little if any data or evidence on which to base a rational assessment of these risks apparent or available.

Decision making in risky situations is a complex cognitive task, usually very dependent on the situation, in which human beings perform in a manner determined by their limited memory and information processing capabilities. Peoples' attitudes to a specific risk vary depending upon issues such as – whether it matters to them, who is affected by each outcome and how far into the future its effects might be felt. For example the degree to which people are prepared to “amber gamble” at traffic lights. The importance we assign to risks also depends to an extent on our moral and ethical values as well as our experience. An individual may take a calculated risk affecting her/himself but may act more or less responsibly where the interests of others are at stake.

In spite of these difficulties risks should be analysed and assessed so that they can be better managed and controlled. If they can be identified, significant risks items can be discussed and efforts can be

made to either reduce their potential impact or, preferably, remove them by contingency planning or by making project changes.

Many of the documented approaches to risk management advocate a process or cycle of stages (Thomson, 1987; Patel, 1994; Kontio, 1997; Royal Academy of Engineering, 2002). An overview of the main stages recommended in most of these approaches is given below.

- 1 Risk Prioritisation. Ranking the list of main dangers by creating a list of important risks (those of high probability and severity).
- 2 Risk Management Planning. Deciding how to address each of these items and developing contingency plans for co-ordinating these individual plans into the overall project plan before the start of the implementation stage.
- 3 Risk Resolution. Attempting to eliminate or resolve the important items of risk before they can have a negative impact.
- 4 Risk Monitoring and Control. Once the project is underway the project manager should track the success of reassessing, minimising and resolving risk items and take further corrective action.

The apparent popularity of, and agreement about, this type of staged lifecycle indicate that it has been accepted by many as a sensible way to approach risk management. One of the biggest problems with these approaches is their tendency to summarise the processes of the stages. Many of them do not give useful guidelines or information for an analyst or manager to follow. For example the first stage is usually labelled: “identify hazards”, or “list all possible failure causes”, or “danger spotting”, yet there are few explanations of how to achieve this objective. Subsequently most of these approaches advise the reader to estimate the consequences and importance of each risk. Again, how one carries out or arrives at this assessment is not clear. It might be helpful to provide more specific and detailed help with these stages.

### **7.1 Risk Identification and Estimation**

While many of the authors and studies mentioned in this paper have reported on surveys about, and typical causes of, IT project failure, and several have recommended ways to try to improve things, none of them seem to have related their work to the development of clear frameworks that provide linked risk analysis tables.

McFarlan (1981) made an early attempt to develop a basic set of questions to assess aspects of the riskiness of an IT project. Lyytinen et al (1996) developed a richer approach questioning the project situation under four broad headings – task, structure, technology and actors. Boehm and Ross (1989) produced a ‘top-ten’ checklist of factors that can adversely affect IT projects. Corder (1989) suggested a categorised and ranked list of what were he suggested the most dangerous risk factors. Barki et al (1991) developed their own way to measure various risk factors and more recently Schmidt et al (2001) and Keil et al (2002) provided pared down lists of what certain experts and users identified as important project risk factors.

These assessments and proposals are however quite simplistic overviews that do not include sufficient range or coverage of the diversity of typical or common IT project risks to allow an analyst to consider a representative sample of possible threats and potential problems. Not only are these summaries inadequate samples but they usually do not provide any scales or criteria to help an analyst estimate each factor’s significance. The next section addresses both of these inadequacies.

### **7.2 Risk Factors**

The first half of this paper discussed and reviewed common mistakes, assumptions, delays and disruptions that can cause an IT project to go off-the-rails or even fail completely. From this analysis of causes of IT project failure it is argued that we can establish a better overall picture of the factors that involve the greatest risk of problems such as cost and time over-run in IT projects. The following risk list is an attempt to capture the most important issues that typically contribute to IT project failure. It includes hints and questions that are supposed to help to explain each issue:

- executive management and user commitment to change and their sense of stability in their jobs (to what extent are they happy with the way things are?).
- clear measurable business case objectives linked to organisational strategy (is there agreement about the aims and deliverables of the project?).
- project size (the larger the project, the greater the risk).

- project definition and plan, (how clear and precise are the Terms of Reference?)
- competence of consultant or manager (has he/she managed this before?).
- importance given to necessary cultural and organisational changes (the client may not realise their significance).
- health and vulnerability of the organisation (is it in desperate need of change?)
- number and quality of competing projects (and availability of resources)
- users experience of technology (less risk if using systems that they are familiar with).
- users ability to identify and explain their requirements and their involvement in the project (the more they can specify needs and take part in the project the more they are likely to want and support the implemented solution).
- number of system interfaces between the proposed system and other systems which the consultant may have less control over (co-ordination and testing are important factors as well).
- potential inaccuracy of time and cost estimates (how reliable are they?).
- functional complexity, known (and any suspicion of, as yet, unknown) complexity must be allowed for.
- number of user departments, (the more departments and bosses there are, the more problems there will be.)
- newness of technology, try not to deal with unknowns since it is risky to be the first to pioneer or try something (fools rush in where angels fear to tread).
- project team's experience of area, (are the development team members familiar with these applications?)
- care to be taken over project monitoring and control (quality assurance)
- learning curve, (how long will it take to adapt, and is the company used to change?)
- reputation and reliability of suppliers (can one trust them?).
- number of vendors / contractors, (incompatibility, interdependence and delivery date problems.)
- number of sites, (is the installation scattered and are there many remote locations?)
- project duration and number of phases, (long projects are more likely to hit problems and later phases may be dependent on the completion of earlier ones and/or earlier phases may require re-work as a result of testing.)

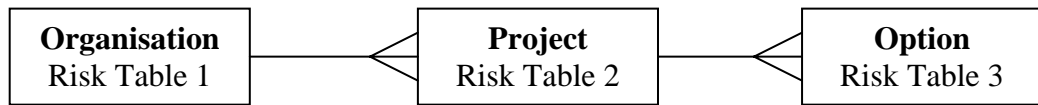
Not surprisingly, it turns out that this list of factors that seem to contribute most to project success and failure is long and rather messy. At first glance it is difficult to see how the list could easily be used as a tool for project risk estimation. There are plenty of issues to be taken into account and questions to be asked but few guidelines on how to apply them. Apart from bearing these factors in mind, how should a risk analyst make use of the list?

Since different factors will be of different significance in different situations at different times - it may be useful to provide for a way to give relative weightings to the various issues. Some factors may be easier to judge and measure than others - suggestions of scales and/or a range of values or references may help the analyst to make assessments. Some factors are more dynamic than others and are likely to fluctuate more quickly in their importance depending on issues such as market conditions and IT system options - it may be better to divide the list into sections to take account of this. Some factors concern the organisation; some concern users and stakeholders; some concern project management and the development team; some concern project objectives, scope and constraints; some concern technology. Furthermore all of these factors are not always applicable or meaningful and a risk evaluation of one project probably cannot be compared directly to another. To summarise, it may be most useful to categorise and subdivide the list and provide for a way to attribute subjective values and weightings to each of the different factors for any project under consideration.

## **8 Risk Estimation Tables**

In this section a set of risk classification tables, intended to help analysts and stakeholders with the process of risk evaluation are explained. It is suggested that the tables are useful when considering how smoothly a project is likely to progress, in highlighting the aspects that may cause problems and in assessing the project's chances of reaching a successful and acceptable solution.

**Figure 1: Risk table relationship.** Any one organisation may have many projects under review, and each of these projects will have several options or potential routes / designs / solutions (each project and option being rated for its costs and benefits and its chances of success or failure).



This structured risk assessment exercise is split into three parts:

- the first considers factors to do with the organisation which are usually slow to change and generally apply whichever business area the project is focussed upon, be it for example: marketing, sales, operations, logistics, HR, e-business or IT (Risk Table 1)
- the second evaluates the basis of the IT project proposal, (Risk Table 2)
- the third assesses the risk potential and feasibility of each business system option, (Risk Table 3).

**Risk Table 1**

Risk Factors	Weight	Risk Potential	Scores					High	Total
			1	2	3	4	5		
		Low							
ORGANISATIONAL									
Urgency of need to change		Little						Vital	
Culture		Innovative, lively						Closed, dead	
Climate / Politics		Open / Friendly						Conflict / Bad feeling	
Business Environment		Static						Rapid Change	
Competition		Low						High	
Growth / Stability		Slow / Stable						Rapid / Unstable	
Management Style		Inclusive						Dictatorial	
Management Experience		Highly competent						Naive	
Responsibilities and Leadership		Clear						Unclear	
Perception of problems		Shared						Disagreed	
Staff characteristics		Willing and Able						Unmotivated, inept	
Adoption of IT		Effective						Ineffective	
Quality Assurance procedures		Well established						Rough and ready	
Available Finance		High						Low	

An analyst or team can consider and guesstimate the risk potential of the individual factors in each table by grading them on a sliding scale from 1 (low risk) to 5 (high risk). There are hints at the low and high ends of every factor to help the analyst make sense of the nature and scale of that issue. Each factor can also be awarded its own weighting according to its perceived significance, say from 0 (unimportant) to 4 (very important). Multiplying the weights by the grade gives a perceived importance value for each factor and these values can be summed to arrive at a total value for each table and an overall score across all three tables. This process can help to give an analyst an idea of views of the level and significance of various risks that may threaten the success of an IT project.

**Risk Table 2**

Risk Factors	Weight	Risk Potential					Total		
		Scores							
		Low	1	2	3	4	5	High	
<b>PROJECT</b>									
Definition of Aims and Objectives		Clear						Vague	
Room for improvement		Great						Little	
Project Plan		Detailed						Unprepared	
Feasibility		Certain						Uncertain	
Size		Small						Large	
Budget		< £10,000						> £1,000,000	
Development Timescale		< 3 months						> 2 years	
Operation / Delivery Date		Flexible						Tight / exact	
Quality / Standards		Minimal / Lax						Strict / Rigorous	
Monitoring and control mechanisms		In place / Good						Do not exist	
Newness of project / Ambitiousness		Familiar / Common						Strange / Unique	
Complexity		Easy						Difficult	
Resource Availability		Plenty						Inadequate	
Project Manager's Experience		Experienced						Inexperienced	
Project Team's Competence		Expert						Naive	
Skills required		Few						Many, varied	
Number of bosses / Owners		One						Many	
No. of People / groups involved		Few						Many	
No. of interfaces to other systems		1						> 10	
Legacy equipment Integration		None						High / many	
Need for Security		Low						High	
Management Commitment		Strong						Weak	
User demand		Keen						Hostile	
Anticipated User involvement		High throughout						Minimal	
Staff Capability		High, adaptable						Low, untrained	

One of the main advantages of these tables is that stakeholders with little knowledge or training about approaches to risk analysis can begin to make assessments quickly. The tables can form the basis on which aspects of different stakeholder views and fears can be ascertained. When used in group meetings or workshop brainstorming sessions this technique can provide a stimulus and focus for discussions of a project's potential strengths and weaknesses. A wide range of influences and issues may be explored as a result of the interactions, disagreements and other questions that this structured approach generates. It can help analysts to think about the likely costs, dangers, benefits and return on investment of project proposals.

This evaluation technique may also be used to make comparisons amongst options, providing a platform for promoting critical reflection of aspects of the desirability of proposed solutions. With experience, over time, the tables can help firms to undertake similar assessments of future project proposals. The tables can also develop an analyst's ability to estimate risk and make comparisons. The more the technique is applied to different situations and examples the more meaningful the assessments become.

**Risk Table 3**

Risk Factors	Weight	Risk Potential	Scores					High	Total
			1	2	3	4	5		
		Low							
OPTION									
Operational		Matches objectives						Fits few of the needs	
Financial		Well within budget						Over budget limit	
Economic return		Good investment						Poor investment	
Social upset / Staff happiness		Improvement						Anger & disruption	
Achievability of Schedule		Easily on Time						May be late	
Amount of change caused		Highly beneficial						Little difference	
User Impact / Retraining needs		Low						High	
Legal / Ethical problems		Few						Many	
Number of Suppliers		1						> 5	
Supplier support		High, reliable						Low, inadequate	
Security Risk		Low						High	
Newness of technology		Tried and tested						Frontier breaking	
Build or Buy		Modular package						Bespoke software	

This kind of analysis is especially useful in situations where an organisation has many competing projects, each of which has several possible solutions. It could be argued that another column should be added to each table, one in which the certainty-of-the-estimate-of, or confidence in, each risk could be assessed and noted. On the other hand however, this may overcomplicate an already busy and questionably mathematical or formulaic model.

### Conclusions

It is alarming that significant numbers of IT projects still fail to deliver benefits on time, within budget and to expectations. A great deal of the £24 billion or so being spent on IT each year in the UK (BCS 2004) is being wasted. Yet studies have been pointing to the same causes of IT project failure for years. As ‘Cobbs paradox’ puts it “*We know why projects fail, we know how to prevent their failure – so why do they still fail?*” (Martin Cobb, treasury board of Canada secretariat, quoted in Unfinished Voyages, 1996). One way to improve this situation, especially for SME procurement projects, might be to carry out a risk estimation exercise that is reasonably easy-to-use by stakeholders and members of the project team and gives a standardised template so that the process of risk estimation can be discussed and focussed on important characteristics. Results from this analysis process can be compared and users can build up an expertise of experience in evaluating projects’ potential for success.

Towards this objective this paper has discussed the issues that many studies confirm as significant causes of failure in IT projects, attempted to convert this range of issues in to a list of risk or threat analysis factors and then proposed a set of three linked tables, containing grouped categories of these risk criteria, each with a likert scale and weighting factor. It is suggested that these risk estimation tables can form a useful part of a feasibility study near the beginning of an IT project before too much is committed.

### References

- APM, 2004, The APM Project Risk Analysis & Management Guide (PRAM), 2e, Association for Project Management.
- APM, 2005, Association for Project Management website, [apm.org.uk](http://apm.org.uk)

Barki H., Rivard S. and Talbot J., 1993, Towards an assessment of software development risk, *Journal of Management Information Systems*, 10 (2), 203-25.

BBC, 2005, "Intelligence system faces delays"  
<http://newsvote.bbc.co.uk/mpapps/pagetools/print/news.bbc.co.uk/1/hi/uk/4421341.stm>

Block R., 1983, *The Politics of Projects*, Yourdon Press, Prentice-Hall, Englewood Cliff, New Jersey.

Boehm, B., 1991, *Software Risk Management: Principles and Practices*, IEEE Software, 8, 1, 3241.

Boehm, B., and Ross, R., 1989, "Theory W software projects management: principles and examples", *IEEE Transactions on Software Engineering*, 15, 902-916.

Bronte-Stewart, M., 2001, "Business Information Technology System Consultancy", Turnberry Publications.

Brynjolfsson, E., and Hitt, L., 1998, "Beyond the productivity Paradox", *Communications of the ACM*, Volume 41, No 8, pages 49-55.

Clegg, C., Axtell, C., Damadoran, L., Farbey, B., Hull, R., Lloyd-Jones, R., Nicholls, J., Seell, R., and Tomlinson C., 1997, "Information Technology: A Study of Performance and the Role of Human and Organizational Factors," *Ergonomics Journal*, Vol. 40, No. 9, pp 851-871.

Computer Weekly, January 2003, Courts Libra system 'is one of the worst IT projects I have ever seen.'

Computing Magazine, March 2003, Government IT problems since 1997.

Corder, C., 1989, "Taming your company computer", McGraw Hill, London.

Cotterell, M., and Hughes, B., 1999, "Software Project Management", McGraw Hill.

Cross, M., October 2005, "Public Sector IT Failures", Prospect, pages 48-52

Cusing, K., November 2002, "Why projects fail. (IT project leadership report by The Cloverdale Organisation)".  
 The Future of the IT Organisation. Computer Weekly.

Dosani F., May 2001, quoted by Robert Scheier in "Stabilizing your risk", *Computer World* magazine.

Ewusi-Mensah K., 1997, *Critical Issues in Abandoned Information System Development Projects*, *Communications of the ACM*, Volume 40, 9.

Feld, C. S. and Stoddard, D. B., February 2004, "Getting IT Right", *Harvard Business Review*.

Fielding R., November 2002, IT projects doomed to failure, *Computing*, vnunet.com.

Fortune, J. and Peters, G., 2005, "Information Systems: Achieving success by avoiding failure", Wiley.

Goodwin, P., and Wright, G., 2004, "Decision Analysis for Management Judgement", 3e, Wiley

Hashmi M., 2009, "High IT Failure Rate: A Management Prospect" *Blekinge Tekniska Hogskola Sektionen for Management*.

Hughes, B. and Cottrell, M., "Software Project Management", New York/ London: McGraw Hill.

Intellect (formerly the Computing Services and Software Association), June 2000, *Getting IT Right For Government*.

ICACA, 2008, "Changing business needs and unmet business expectations are leading causes of technology project failure", ICACA Web site news release.

Jaques R., April 2004, UK wasting billions on IT projects, *Computing*, vnunet.com.

Keil M., Cule P. E., Lyytinen K. and Schmidt R. C., 1998, *A Framework for Identifying Software Project Risks*, *Communications of the ACM*, 41, 11, 76-83.

Keil, M., Tiwana, A., and Bush, A., 2002, "Reconciling user and project manager perceptions of IT project risk: a Delphi study." *Information Systems Journal*, Pages 103-119, Volume 12, Blackwell Science Ltd.

Kelly, L., July 2003, "Government reexamines IT failures", *Computing*.

Kellogg, 2003, "IT Project Management: Challenges and Best Practices", Kellogg School of Management.

Kontio, J., 1997, "The Riskit method for software risk management" version 1 CS-TR-3782 / UMIACS-TR-97-38, *Computer Science Technical Reports*, University of Maryland (and [www.rdware.com/Riskit](http://www.rdware.com/Riskit)).

Kontio, J (2001) *Software Engineering Risk Management: A Method, Improvement Framework, and Empirical Evaluation*, R & D-Ware Oy. (See <http://www.rdware.com/Riskit>)

Lyytinen, K. and Hirschheim, R., 1987, "Information System failures: A survey and classification of the empirical literature", in *Oxford Surveys in Information Technology*, Oxford University Press.

Lyytinen, K., Mathiasen, L., & Ropponen, J., (1996), "A Framework for Software Risk Management", *Scandinavian Journal of Information Systems*, 8(1), 53-68.

McCue A., July 2002, "Treasury warns of over-optimistic IT projects", *Accountancy Age*.

McFarlan F. W., 1981, "Portfolio Approach to Information Systems", *Harvard Business Review*, 59, 5, 142-150.

McManus J and Wood-Harper T, 2008, "A study in project failure", BCS, *Articles, Project management*.

NAO/OGC, 2005, "Common Causes of Project Failure", *National Audit Office and the Office of Government Commerce*.

NAO, 2006 "Delivering successful IT enabled Business Change", *National Audit Office and the Office of Government Commerce*.

Naughton, J. and Peters, G., 1976, "Systems and Failures", Open University Press, Milton Keynes.

Oakes G, 2006, "There's No Success Like Failure...", *The Financial Times*.

OASIG, 1996, "The performance of Information Technology and the role of human and organisational factors"  
<http://www.shef.ac.uk/~iwp/publications/reports/itperf.html>.

Office of the e-envoy, November 2002, UK online annual report.

Ould, M., A., 1999, "Managing Software Quality and Business Risk", Wiley.

Patel, J., 1994, quoted in "Managing Risk: Critical Issues for Survival in the 21st Century", Alan Waring and Ian Glendon, Thomson Business Press.

Peterson D. K., and Kim C. S., 2000, "Information system objectives: effects of experience, position level and education on developers", *Journal of Information Technology Management*, Volume 11, ISSN #1042-1319.

POST, July 2003, "Government IT projects – Analysis of the problem", Parliamentary Office of Science and Technology, Report 200.

Public Accounts Committee, August 2002, Improving Public Services through e-government, HC845.

Robinson, B., 1994, "Social context and conflicting interests", Second BCS conference on Information System Methodologies, Edinburgh, pp 235-249.

Royal Academy of Engineering, 2002, Common Methodologies for Risk Assessment and Management, and The Societal Aspects of Risk, The Royal Academy of Engineering, London. (See <http://www.raeng.org.uk/news/publications/list/default.htm?TypeID=2&PubType=Reports>)

Sauer, C., 1988, "The value of case studies in understanding organisational aspects of information systems", Internal paper, Department of Computer Science, University of Western Australia.

Sauer, C., and Cuthbertson, C., November 2003, "The state of IT project management in the UK." Templeton College, Oxford University.

Sauer C, Gemino A and Reich B H, 2007, "The impact of size and volatility on IT project performance", Communications of the ACM, Volume 50, issue 11.

Schmidt, R., Lyytinen, K., Keil, M., Cule, P., 2001, "Identifying Software Project Risks: An International Delphi Study", Journal of Management Information Systems, Pages 4-36, Volume 17, Number 4.

Select committee on public accounts report "Improving the delivery of Government IT projects" (1999), (<http://www.parliament.the-stationery-office.co.uk/pa/cm199900/cmselect/cmpublic/65/6502.htm>)

Senior, J., February 2003, "Director's notes", IT management, Computer Weekly.

Standing C, Guilfoyle A, Lin C, Love P, 2006, "The Attribution of Success and Failure in IT Projects", Journal of Industrial Management and Data Systems, Volume 106, number 8.

Stowell, F. and West, D., 1994, "Client led Design", McGraw Hill

Sumner M., 2000, "Risk Factors in Enterprise-wide/ERP projects", Journal of Information Technology, 11, 317-327.

Taylor, A., 2001, "IT projects sink or swim", British Computer Society, Review 2001.

Telegraph, July 2005, "Government IT projects are not checked properly", [www.telegraph.co.uk/news/main.jhtml?xml=/news/2005/07/05/nit105.xml](http://www.telegraph.co.uk/news/main.jhtml?xml=/news/2005/07/05/nit105.xml)

The Guardian, 12<sup>th</sup> March 2009, "Abandoned Jail and Probation Computer Project Cost £155m."

The Register, November 2002, "IT project failure is rampant" – KPMG, [electricnews.net](http://electricnews.net)

The Standish Group, 1995 and 2006, CHAOS, The Standish Group International.

Thompson, J. R., 1987, "Engineering Safety Assessment", Addison Wesley Longman, Harlow.

UK Passport Service Annual Report and Accounts 2002-3, July 2003, Passport Service, HC969.

Unfinished Voyages, 1996, A follow-up to the CHAOS report, The Standish Group International.

Vickers, G., 1981, "Some implications of system thinking", reprinted in the Open Systems Group Systems Behaviour, Harper and Row, London, pp19-25.

Verner J, Sampson J, Cerpa N, 2008, "What Factors Lead to Software Project Failure?", International Conference on Research Challenges in Information Science, RCIS 2008.

Waring, A., and Glendon, I., 1998, "Managing Risk: Critical Issues for Survival in the 21st Century", Thomson Business Press.

Warne, L., 2003, "Conflict and politics and information systems failure: a challenge for information system professionals and researchers", Socio-technical and Human Cognition Elements of Information Systems, pages 104 – 134.

Weigers K., 1998, "Know your enemy: software risk management", Software Development, 6.

Willcocks L. and Margetts H., 1994, "Risk Assessment and Information Systems", European Journal of Information Systems, 3, 2, 127-138.