Obstacles to the modelling of the causes of project success and failure

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Abstract

Our research seeks to improve the management of the risk of failure in information system development projects. As such it clearly needs to address issues of causality. A desirable outcome would be the construction of models which could indicate the likelihood of project failure for a given set of circumstances, based on the analysis of the performance of past projects. This paper reports on some of the obstacles to the construction of such models. In particular it considers:

- the diversity of perceptions and the problems of constructing a consensus between project actors with regard to the real circumstances of a project;
- the problems of diagnosing the causal relationships between project variables where more than one variable has an influence on a project outcome;
- the confounding influence on causal analysis of project actors who, quite rationally, desire a positive outcome to the project and so work to reduce the influence of negative outcomes.

The last characteristic of project behaviour can lead to non-intuitive outcomes when projects are considered retrospectively: for example that project failure can be associated with the deployment of more, rather than less, capable staff to a project.

In some ways this paper reflects the problems that can occur when researchers who come from primarily an engineering management background stumble unsuspectingly into what turns out to be social science research.

1. Introduction

It is a truism that IT project are prone to failure – see, for example, Lucas (1975), Sauer (1993), Fortune and Peters (1995), Flowers (1996). This justifies research into IT project risk as a worthwhile activity. Possible objections to the inclusion of research on this topic in a conference on business research methods can be met on a number of grounds: most IT development projects within organisations are essentially business change projects, and change management sits comfortably within business schools. Indeed, information systems research and teaching straddles both business schools and computing departments as is evidenced by the papers presented at the UK Academy of Information Systems (UKAIS) annual conferences. However research into IT risk management is not completely comfortable in its position at an intersection of business and IT research. Software project management as a subject finds a modest niche within the broader discipline of software engineering. While there are many approaches to research within the business environment there is an impression that a dominant research paradigm in the UK at least is a qualitative or interpretivist one as championed by Walsham (1999), and Smithson and Hirschheim (1998). Given the ‘engineering’ in ‘software engineering’, it comes as little surprise that more quantitative measurement approaches that some would label ‘positivist’ tend to be favoured. This is exemplified by the developments of such techniques as function point counting (Albrecht and Gaffney 1983, Symons 1991) which attempts to assess the size of development work and cost models, such as that of Boehm’s (1981) that attempt to calculate the probable effort needed to develop a particular software artefact. Given the close proximity of software engineers and computer scientists there should be little surprise at the frequent attempts to build computer models that aspire to mimic organisational behaviour in some way – in this
subject area of this paper this is exemplified by Abdel-Hamid (1986) and slightly more recently by Williams et al (1995).

IT development projects are commissioned and executed by organisations and are thus socially constructed. The concept of project failure is also largely socially constructed. For any project, a set of expectations which can vary between different stakeholders is established and a project is initiated which then attempts to fulfill those objectives. It has been suggested that in general success criteria for projects are often formulated in such a way as to allow for politically advantageous interpretation on completion (Gowler and Legge 1978). However actual implementation often involve the establishment of contractual obligations which are rigidly defined, and where success and failure to meet these obligations is relatively easy to establish. Beyond that however the actual acceptance or approval of a project’s outcomes may vary from the original declared expectations. Concorde is transformed over the years from being a commercial failure to being an iconic triumph. The Mars Explorer project can be claimed to be a success for its contributions to engineering research and its raising of public awareness despite what might appear to be a clear failure, i.e. disappearing on impact (Johnston 2004).

Despite this fuzziness at what might be called the political level, at the level of actual implementation technicians are executing well-defined tasks, sometimes constrained by very rigid methodologies, to produce closely specified products using deterministic tools. The authors contend that the conflicts between the different schools of thought with regard to research paradigms mirror the differences between the political nature of higher level project management and the more deterministic nature of the detailed execution of a project creating technological artefacts.

This paper attempts to address these issues by examining a concern central to research theory: that of causality. The interrelated activities of planning, effort and cost estimation and risk analysis are based on the premise that the outcomes of current and future activities can be predicted. This implies some sense of the chains of causality between current decisions and final outcomes. The assumption that people tend naturally to devise strategies and plans to achieve objectives appears to be challenged by some scholars such as Suchman () who seem to emphasise the behaviour of humans as largely reacting to events rather than being proactive. The authors of this paper would argue that any collaborative undertaking between groups of people requires some element of planning to facilitate co-ordination but recognise that in the execution of these plans there is a degree of improvisation and modification. A particular case of this is that the coordination of tasks carried out by different people requires some assessment of the effort and elapsed time required to complete tasks. However some tasks will not go according to these forecasts because of the uncertainties inherent in the nature of the activities or because of unforeseen events emerging from the environment of the project.

In the remainder of this paper, section 2 provides a brief review of the current state of the art as regard to project risk. This draws attention to the some of the shortcomings we perceive in the current approaches to risk analysis. Section 3 outlines a possible line of attack on this problem using a particular research approach based on the mapping of the perceived chains of cause and effect which may lead to favourable and unfavourable outcomes of planned endeavours. It is emphasised that the approach is a generic tool that can be used in a variety of research domains. Section 4 describes briefly some of our experience of using the approach. Section 5 examines some of the problems that have emerged from use of the technique and how we have attempted to overcome them. Section 6 returns to the literature on causality to examine if this can shed light on the problems highlighted.

2. The current state of risk research

There is sometimes a sense that some things are too important to be left as just a subject of research for the academic community. IT development projects have a significant impact on both businesses and not-for-profit organisations. In 2002-2003 the United Kingdom central government spent more on contracts for IT than they did on roads (about £2.3 billion as opposed to £1.4 billion). The Standish group in the United States reported that of 13,522 projects surveyed, only a third were successful: 82% of projects were late and 43% exceeded their budget (National Audit Office 2004). Because of these pressures work in this area by practitioners has probably outweighed academic research.

The risk concepts applied in IT were originally based on well-established general engineering principles ( see, for example, Boehm 1991, Fairley, 1994). A central idea here is of risk exposure, a
measurement of risk that is calculated by multiplying the cost of the damage if the risk does occur by the probability of the risk occurring so that if, for example, a fire could cause €10,000 of damage and had a 1% of occurring then the risk exposure would be €100. This amount would be a crude equivalent to the size of an insurance premium to cover the risk.

In the case of risks specific to IT projects, Boehm and Fairley produced two of the earliest of many checklists of possible risks. Boehm went further and identified possible risk management tactics to deal with each risk. Among the many contributions of Boehm there was also the promotion of an overarching spiral model of development where the early stages of a project are tentative as areas of uncertainty are explored, and each later stage is initiated by a decision-making process to decide whether the uncertainties related to the project have been reduced to such an extent that the next tranche of investment is justified (Boehm 1988).

A major problem with risk management is the identification of candidate risks. Risks by their very nature can be unexpected and can come from a variety of quarters. One approach is to examine case studies of project failure – see for example, Lucas (1975), Sauer (1993), Morris and Hough (1987), and Flower (1996). A frequent shortcoming of these works, which are often produced for a practitioner rather than a research audience, is that there is often a lack of rigour in the conclusions that are drawn from the circumstances of failure. Just because a particular approach does not work, it does not prove that a favoured alternative approach will.

Another approach is to collect and analyse quantitatively data from many projects. While this may not find favour in some interpretivist circles the principle has, historically, worked profitably for insurance companies. The effectiveness of such analyses depends on the historical records being restricted to projects with certain well-defined attributes so that realistic comparisons can be made. Van Genuchten (1991), for example, examined the reasons why individual software development tasks were late. This type of analysis is often associated with effort estimates as the identification of a risk often leads to an increase in effort to deal with the risk.

Another approach is to ask knowledgeable project managers to identify the comment causes of failure – see for example Keil et al (2002) . Moynihan (2000) used repertory grid analysis to study the way that project managers perceived and coped with risk concerning the uncertainty of requirements. A common outcomes of the project manager surveys are lists of common risks. Some of these have then become enshrined in risk checklists for project planners. A frequent failing of such lists is that causes are not always clearly distinguished from effects. For example, one of the risks identified by Boehm that of ‘developing the wrong user interface’ could be a consequence of another risk ‘personnel shortfalls’.

Valuable work has been done to formalise the categorisation and attributes of risk, for example, RiskIT and Euromethod (which subsequently became ISPL). ISPL for example identifies a number of situational factors which may lead to defined negative outcomes. Risks are divided into those that relate to complexity and those that relate to uncertainty and tailored strategies such as the use of evolutionary approaches to clarify uncertainties and incremental approaches to break down overly complex systems into simpler components are indicated where appropriate.

A major problem with all risk research is that the probabilistic nature of risk makes the verification of models and theories problematic. It is generally easier to trace the causes of the presence of something than its absence. The fact that a project did not experience a problem is not easily attributable to a particular factor when it could well be the case that the problem might not have occurred anyway.

3. Causal mapping

Many of the problems related to risk research identified in section 2 relate in some way to problems of causality. Our research attempts to evaluate the contribution that the use of causal mapping could make to the amelioration of these problems. The most prominent early exponent of this approach was Axelrod (1976). In the United Kingdom, a group of researchers grouped around Colin Eden have been particularly associated with this type of mapping. An overview of the development of causal mapping can be found in Narayanan (2005).

Axelrod referred to ‘cognitive maps’ which were defined as ‘a specific way of representing a person’s assumptions about some limited domain such as a given policy problem. It is designed to
capture the structure of a person’s causal assertions and to generate the consequences that follow from this structure.' (Axelrod 1976, page 55).

The map consists of a number of points or nodes which represent concept variables, factors that have a bearing on the domain of interest and each of which can take a range of values. Arrows between the nodes represent assertions about the influence of one concept variable on another. The influence could be positive or negative and it is possible (but not essential) to assign some indication of the relative strength of the influence.

Figure 1 A fragment of a Revealed Causal Map

Figure 1 represents the assertions that experienced staff are more likely to produce good quality products but that time pressures are likely to have a detrimental effect. The better the quality of the product, the less the time that will have to be spent on remedial work. The more that remedial work has to be carried out, the greater the time pressures on developers are likely to be.

These days (2006), the preferred term for this kind of model is a ‘revealed causal map’. A problem with the term ‘cognitive map’ is that it might imply that researchers are attempting to examine matters that might be the domain of psychologists. Revealed causal mapping can only reflect the subjects’ declared beliefs. As the maps often relate to matters of what are in some way ‘public policy’ which is based on shared perceptions, it is argued that this is satisfactory. ‘Causal mapping’, on the other hand, might be seen as implying some attempt to model the actual operation of physical or organisational systems – which is a characteristic of other, different, approaches such as that of systems dynamics. It is people’s perceptions of the causal relations between variables that is being modelled. A particular type of map that is sometimes used – reasoning maps – which are used to analyse the grounds on which people make decisions makes the nature of these maps clear.

It needs to be emphasised that concept variables are distinct from events. A particular type of causal map might be used by, for example, accident investigators, to trace the chain of events leading to a known outcome. As a single instance of a chain of historical events that is at least in theory knowable is involved, the model created can be deterministic. Revealed causal maps on the other hand are at a higher, more generalised, and more probabilistic level.

Revealed causal maps have been used in a variety of ways and have been based on a number of different sources of information. They can, for example, be based on text: one pioneering study by Ross (1976) analysed the contribution of Gouverneur Morris at the 1789 United States constitutional convention. They can be based on interviews with individuals or can be used to facilitate group brainstorming sessions to capture the consensus about future organisational direction (Bryson et al 2004).

4. Experience with revealed causal mapping

In this section the experience of the authors in the application of revealed causal maps (RCMs) to the study of project risk is described. The use of RCM to analyse perceptions of the causes of a perceived project failure is explored. Some difficulties with the approach are noted.

The use of RCMs to study participants’ perceptions of the causes of project failure seemed to offer a promising avenue to explore. The first step in this exploration was a pilot experiment using a
group of Masters students. These were given a brief explanation of the approach and were then presented with a textual description of a scenario involving a problematic project. The students were asked to produce, in groups of four or five, RCMs of their perceptions of the causes of the problems in scenario.

The students found the ideas of RCMs easy to grasp. The most striking outcome was the variation in the maps that were produced. There were differences in the relevant concept variables identified and also in the relationships between concept variables. A significant problem when comparing maps was deciding whether concepts with slightly different names were really the same. The literature on the subject distinguished between ideographic elicitation where subjects are encouraged to use their own terminology and nomothetic where researchers provide a standardised list of concepts from which the subjects can choose. The nomothetic approach facilitates reliable analysis and model-building but at the risk of imposing the worldview of the researchers on their subjects. Although we started with an ideographic stance, we gravitated towards the nomothetic on pragmatic grounds. It is argued that any use of a shared language carries some risk that the poverty of the vocabulary in some area could constrain the precise communication of ideas.

It could be argued that the differences between the student groups could be put down to their lack of experience. On the other hand, a more uniform perception of the circumstances of the given scenario might have been expected because all participants were working from an identical textual description.

This pilot was followed by a field experiment involving IT practitioners who had participated in a large project that had been widely regarded as being problematic. The project was to implement a bespoke human resources (HR) system within a large government organization in an Arabian Gulf state.

RCMs relating to the perceived causes of problems in the project were drawn up by each individual participant with the help of a facilitator. This was followed by two group sessions involving the same participants where maps were built collaboratively. One group consisted of IT developers and the other of managers. The maps produced by individuals varied considerably. This might have been justifiable as each participant would have their own, possibly restricted, view of the project. These differences in viewpoint did not impede the agreement of common maps for the two groups, but once again there were significant differences between the two consensual RCMs.

One, perhaps not surprising, reason for the differences was for each group to lay the responsibility for the failure at the feet of the other groups, so that the developers blamed ‘lack of project management’ while the managers blamed ‘poor work ethic’. Initiating dialogues using the RCMs as a starting point was seen as a useful means of encouraging organisational learning. However, the authors wanted to go further and attempt the creation of a more generalised model that could be used to support the planning of future projects.

This further step requires the identification of a commonly agreed set of relevant concept variables which itself is a considerable research challenge. A requirement of a model that can provide useful advice is that it needs to be able to take account of situations where there are both positive and negative influences on an outcome. This is illustrated in Figure 1 where the concept variable ‘quality of product’ is influenced positively by ‘experience’ but negatively by ‘time pressure’. This requires some consideration of the relative strengths of the different concept variables that influence outcome. It further required some idea about how the influences on different contributing influences might be combined to produce a certain outcome. There would appear to be at least four different methods of combination:

**Additive** where the influence of different variables can be simply added together: for example, water from different sources such as a high tide and abnormal rainfall combining to create a flood;

**Compensatory** where a negative influence can be reduced by another, positive, influence: for example training might be able to compensate for lack of experience;

**Disjunctive** where it is enough for just one of the influences to be present to trigger the outcome, for example, several qualified people might be interested in doing a particular job but the appointment of any one of them would fill the vacancy;

**Conjunctive** where at least two influences must be present at the same time in order to trigger the outcome, for example, for sales in an industrial sector to increase there must be people both willing to sell and people willing to buy.
This suggests that when interviewing experts about their perceptions of causality within their specialist domain we need to explicitly discuss the mechanisms by which influences are combined.

Further examination of the causes of risk has highlighted the way that the purposeful nature of a project when perceived as a system can mean that the direction of causality may not be as it first appears. This is caused by the presence of motivation. For example, a simple model might suggest that the drinking of water causes a reduction in the feeling of thirst. However, it could be equally argued that the feeling of thirst causes people to drink water. An example of this from some earlier research (Hughes 1997) was when statistical analyses showed that the months of experience of software developers had a positive correlation with the amount of effort needed to implement changes to existing software. Intuitively you would expect the more experienced staff to be more productive and therefore to do work more quickly. A likely explanation for the actual results was that managers were able to assess the difficulty of the different software components to be amended and allocated the most experienced staff to the most difficult components. It was noted that a similar unexpected relationship, in this case between ‘competence’ and project success, was also found by Wohlin at al (2000).

5. Conclusions

The authors feel that to a certain extent they were quietly working to provide software engineers and IT practitioners with some advice on how to avoid some of the pitfalls associated with IT projects who have suddenly found themselves ambushed by a range of conceptual issues relating to concepts such as causality and intentionality.

When trying to forecast the behaviour of organisational systems is seems obvious in retrospect that project actors will naturally take steps to avoid the detrimental effects of negative factors that can affect project outcomes. In assessing the likelihood of project success both possible negative circumstances and the defensive reactions of system managers need to be taken into account. It still remains the case that many completed projects are regarded as failures despite the defensive actions taken. This suggests that there are a third set of factors that relate to the sensitivity of the organization to recognise and respond to the warning signs of possible negative outcomes.

It thus appears that our risk model building needs to take into account issues of organizational learning and the way that the stakeholders in a project construct a common understanding of the nature of the problems to be solved and the tasks to be undertaken in order to achieve success.

References

National Audit Office (2004) *Improving IT procurement*
Suchman L. Situated Action
Walsham, G. (1999) ‘Interpretive evaluation design for information systems’ in Willcocks, L.P. and S. Lester *Beyond the IT productivity paradox* John Wiley and Sons, Chichester