DOI NUMBER: 1019255/JMPM03020

IT PROJECT FAILURE, TERMINATION, AND THE MARGINAL COST TRAP

Jens Schmidt

Head of Research Centre for Government IT, Codirector, Danish Institute for IT Program Management, IT University of Copenhagen, Rued Langgaardsvej7, DK-2300 Copenhagen S
Mobile: +4540814775
Email: jesc@itu.dk

Abstract: There is a gap in the research literature with respect to explaining why some failing IT projects are allowed to continue instead of being terminated. Part of the problem is a gap with respect to an accepted general definition of IT project failure. This is significant because varying definition of IT project failure gives rise to misunderstandings in research and practice. The use of the derogative term "failure" is in itself problematic. This article gives a) an overview of what is meant by IT project failure in the literature, b) an updated set of IT project performance criteria associated with the attribution of failure, and c) a new argument for the theoretical predictability of IT project termination - the marginal cost trap. The article furthermore presents d) an outline of how these findings can contribute to preventing IT project failure. The research methods are a hermeneutic literature review (content analysis), small-n case studies (plausibility probes), and abductive theory generation.

Keywords: Information technology, IT project management, IT project performance, IT project failure, IT project termination

1. Introduction

Many IT projects are considered as failures, and IT project failure is often associated with overspending. According to recent research almost one in five IT projects spend 4.5 times the original budget (Flyvbjerg & Gardner, 2023). Why are such failing IT projects not terminated before completion? And is there more to IT project failure than cost performance?

According to some estimates, $81bn was spent in 1995 on cancelled software projects in the US alone (Standish, 2014), in the EU in 2004, €142bn was written off on failed IT projects (McManus & Wood-Harper, 2008). IT project failure is a significant problem, and worth investigating. Such investigations have potential for improving the skills of individuals, the performance of organisations (Fortune & Peters, 1995), and the performance of the industry as a whole (Kerth, 2001; Kusek, Pestidge, & Hamilton, 2013).

It is not a new idea that we should study project failure to improve future project performance (Abdel-Hamid & Madnick, 1990; Boddie, 1987; Chua, 2009; Collier, DeMarco, & Fearey, 1996; Dalcher, 1994; Dalcher, 2010; Flyvbjerg, 2006; Fortune & Peters, 1995; Fortune & Peters, 2005; Gauld, 2007; Gilbreath, 1986; Hughes et al., 2016; Johnson, 1995; Kerth, 2001; Kusek et al., 2013; Nelson, 2008; Sauser, Reilly, & Shenhar, 2009). Knowledge about the characteristics of past IT project failure is helpful for efforts to prevent future IT project failures. If knowledge about past project failures is ignored, circumstances leading to past project failures are likely to reincarnate as risks in future IT projects. In the field of aviation, for example, investigations of accidents have led to better overall aviation safety. "Independently advancing transportation safety" (NTSB, 2016b), is the mission statement of the US National Transportation Safety Board, and the NTSB "determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents" (NTSB, 2016a). The idea of drawing on experience from aviation in the study of information systems failure dates back to the 1980's (Wise & Debons, 1987).

The IT projects in focus in this paper are run-of-the-mill commercial IT projects as unique endeavours performed by temporary organisations to provide services or products, achieve objectives (PMI, 2017), and provide benefits (Holgeid et al., 2021). Such projects may be contracted or delivered by internal resources on quasi-commercial terms, and delivered by plan-driven or agile approaches (Sommerville, 2016).

The cases studied in this work are Danish government IT projects, where benefits by stipulation fall into two categories: Efficiency improvements or quality improvements. Even given the focus in this paper on commercial IT projects, there is more to be said about project failure criteria than economic performance, as the literature shows. Furthermore, we shall argue that economic project performance should be evaluated differently before *commitment- to-build* than after. This is relevant for IT project termination, as can be explained by *the marginal cost trap* mechanism presented in this paper.

But to avoid misunderstandings in investigations of IT project failure, we must first establish the performance criteria that stakeholders associate with IT project failure, in other words establish a - currently unavailable - authoritative, and general definition of IT project failure for the type of IT project that we want to investigate. *This is the aim of this paper.* The literature already offers multiple varying definitions of IT project failure, and it is reasonable to require of a new definition that a) the definition of IT project failure should comprehensively consider the academic and professional literature, and b) the definition of IT project failure should be useful for explaining empirical aspects of IT project failure, for example project termination. Current explanations of why failed projects are not always terminated rely on *escalation of commitment* from behavioural psychology (Flyvbjerg, 2021; Keil et al., 2000; Staw, 1981). In this paper, we present a new, different, complementary, and less sophisticated theory of project termination based purely on IT project performance: *The marginal cost trap*. This is significant because *the marginal cost trap* is simple to apply in a project management context.

2. Research Methodology

The main questions addressed in this paper are: How should we conceptualise and define IT project failure in a way that is useful for investigating IT project failure in order to prevent future IT project failures? or simply: *What is IT project failure?* To answer this question, we have first performed a critical literature review and content analysis. Subsequently, we have tested the quality of the resulting definition of IT project failure by applying it to a small number of cases and additionally asked: *Why are some failed IT projects terminated, others not?*

We have conducted the following steps to answer the two questions:

1. Critically reviewed the literature (Boell & Cecez-Kecmanovic, 2014) that *explicitly* defines or describes IT project failure.
2. Analysed the above literature, made selections and necessary adaptations considering a) the of unit of analysis (*the project*, see below) and b) the type of IT project in focus (run-of-the-mill commercial IT projects) in order to develop a definition of IT project failure in terms of a set of performance criteria that stakeholders associate with IT project failure synthesised from the literature.
3. Studied a small number of cases of failed IT projects - failed major government IT projects in Denmark from 2012 to 2015 - to validate the new definition of IT project failure. The validation consisted in qualitatively matching the criteria of the new definition of IT project failure with the characteristics of the empirical cases, including termination.
4. Developed a theory of IT project termination leveraging the new definition of IT project failure, and validated it by plausibility probing case studies of failed government IT projects (Collier, 1999; Flyvbjerg, 2006; George & Bennett, 2005; Levy, 2008; Lipton, 2001) based on publicly available sources and thousands of internal project documents uniquely made available by Danish government agencies.

The methodology of the paper is consistent with the epistemological and ontological commitments of critical realism (Bhaskar, 2008; Bhaskar & Hartwig, 2016; Carlsson, 2011; Hoddy, 2019; Mingers, 2000, 2004; Mingers, Mutch, & Willcocks, 2013; Wynn Jr & Williams, 2012). The literature review method followed is consistent with the iterative approach of database search combined with “snowballing” of Boell and Cecez-Kecmanovic (2014) rather than the comprehensive literature reviews already available in the literature, for example Fortune and White (2006), Hughes, Dwivendi, Simintiras and Rana (Hughes et al., 2016) or Moradi, Kähkönen, and Aaltonen (2020). This approach follows Boell and Cecez-Kecmanovic’s hermeneutic methodology for conducting literature reviews and literature searches, whose double hermeneutic circle framework based on Gadamar and Wittgenstein caters for taking the researcher’s prior knowledge into account.

Following Morris (2013) we take the most relevant unit of analysis for this study to be *the project*, i.e., a combination of the temporary organisation (Packendorff, 1995) and the business undertaking, as opposed to for example the institutional level (Morris, 2011), the enterprise (Artto & Wikström, 2005; Smyth & Morris, 2007), or the portfolio.

3. Literature Review, Concepts of IT Project Failure

We have found considerable variation in notions and definitions of project failure in the academic and professional literature (see appendix). “IS failure is not a well-defined concept” (Sauer, 1999) yet important (De Bruyne, Moens, & Vanhoucke, 2021; Ika, 2009; Thomas & Fernández, 2008). “[A]l though studies have attempted to articulate an accepted theory of IS failure the literature has demonstrated many alternative views of definition and causes.” (Hughes et al., 2016). Avoiding project failure, or “project distress” (Baghizadeh, Cecez-Kecmanovic, & Schlagwein, 2020) is a precondition for project success, and understanding project failure will inform efforts to improve project performance. IT project failure is not trivially related to definitions of project succes as opposites, contradictory, or mutually exclusive (Fincham, 2002; Ika, 2009), so IT project failure merits analysis as its own category.

The word “failure” is a problem in itself. In everyday language “failure” is a derogative, pejorative, contentious and stigmatising term synonymous with “delinquency”, “neglect” and “oversight”. “Failure” is a final value judgement rather than a neutral and continuous assessment. No project professional wants to be associated with failure, and that makes it difficult to appropriate the word for technical use. So where possible, we will use more neutral terms for project performance assessments that also allow a continuous rather than discrete grading of performance. Additionally, some authors highlight that the attribution (Standing et al., 2006) of “failure” to a project is a complex and necessarily ex-post evaluation (Kerzner, 2014a; Sauer, 1993, 1999) contingent on perspective and varying and unpredictable criteria only knowable ex-post. If even that: Is the Sidney Opera House a project success? Views vary within the project management research community. Our preference for neutral performance terms, where possible, will still allow us to address the question of which performance criteria for a certain type of project, a certain type of stakeholder will associate with an ex-post attribution of failure.

This section reviews what is meant by project failure in the literature on projects and IT projects, including:

1. The triple constraint view of project failure
2. A systems approach to failure (Bignell & Fortune, 1984; Fortune & Peters, 1995)
3. The anatomy of project failure and success, the dimensions of project failure and success of Morris and Hough (1987)
4. Project failure as expectation failure (Lyytinen & Hirschheim, 1987)
5. Termination as project failure (Pinto & Mantel, 1990; Sauer, 1993)

3.1 The triple constraint view of project failure

It is a widely held and often implicit view that project failure is the failure to deliver some predefined scope within an accepted budget and timeframe (Agarwal & Rathod, 2006; Cole, 1995; Glass, 1998; Jones, 1995; Jones, 1996; PMI, 2013, 2017; Standish, 1995, 2013, 2014; Yourdon, 2003).According to the Project Management Institute (PMI) a project is “a temporary endeavour undertaken to create a unique product, service or result” (PMI, 2017) and: “[...] the success of the project should be measured in terms of completing the project within the constraints of scope, time, cost, quality, resource, and risk as approved between the project managers and senior management.” (PMI, 2013). This view of project success takes project changes into account by making success relative to “the last baselines approved by the authorized stakeholder” (PMI, 2013). A different view is that the *original budget* is the point of reference (Budzier, 2014; Cole, 1995; Ewusi-Mensah, 2003; Flyvbjerg et al., 2018; Glass, 1998; Standish, 1995). These two views on the budget criterion for project performance are obviously different, unless they are bridged by adequate contingency provisions built into original plans.

A closer look at proponents of the triple-constraint criterion reveals varying degrees of forgivingness in the distinction between success and failure. Some authors allow a grace margin, for example cost overruns of 30% (Cole, 1995), 50% (Jones, 1995), or 100% (Glass, 1998), whereas PMI sensibly implies that changes and plan deviations should be absorbed by revisions of the plan baseline.

Some authors make a distinction between on the one hand *project failure*, and on the other hand *project management failure*, or between process and correspondence failure (Dalcher, 2014b; Fortune & Peters, 1995; Lyytinen & Hirschheim, 1987). Project failure means delivering outputs that are not fit for purpose (functionality), and project management failure means failure to produce the planned outputs within predefined constraints, e.g., budget and schedule.

This division represents a clear separation between design and construction, which to some academics, including Morris (2013 and personal communication), is fundamental to project management.

3.2 A systems approach to failure

According to Bignell and Fortune (1984): “[...] failure can most often be expressed simply as a shortfall between performance and standards". By evaluating performance against "standards", rather than plans, Fortuna and Bignell's concept of failure takes into consideration that plans and "standards" (what the plans *should* be) may differ. Gilbreath (1986) makes a similar point. Fortune and Peters (1995) also offer an interesting classification of failure types in general: 1) objectives not met, 2) undesirable side effects, 3) designed failures, as for example a fuse that is designed to fail in order to protect people or equipment, and 4) inappropriate objectives. The idea of "inappropriate objectives" covers the problem of "building the wrong thing", and the idea of "undesirable side effects" offers another expansion of the triple constraints view of failure as for example Morris and Hough's considerations of expectations of secondary stakeholders (Morris & Hough, 1987). "Designed failures" may be understood as predefined exit criteria.

3.3 The anatomy of project failure and success

Morris and Hough (1987) presented early on a comprehensive framework for understanding failure and success:

"Morris and Hough were among the first to develop a more comprehensive frame- work on the preconditions of project success [...]. They addressed success as involving both subjective and objective dimensions, success as varying across the project and product life cycle, and success as being based on different stakeholder perspectives" (Müller & Jugdev, 2012).

Furthermore, Morris and Hough's framework includes considerations of contractor's commercial performance, which is a relevant concern for large customers of project services, for example governments, or when considering the resource allocation and the division of labour of the economy as a whole. Concern for the profitability and sustainability of contractors may also be driven by concerns for negative effects of contractor default both in the construction and maintenance phase. Corporate social responsibility may be an additional motivation for the concern for the economic health of contractors. It should be noted that contractors may decide to accept a short-term loss to gain long term competitive advantages, see e.g., Huang Chua and Myers (2018). Morris and Hough concluded early on that there is more to project failure than cost, time, and technical output. Their four measures also take stakeholder expectations, value for contractors, and proper termination into account in their proposal (Morris, 1997; Morris & Hough, 1987; Morris, Hough, & Major Projects Association, 1986):

"Project functionality: Does the project perform financially, technically, or otherwise in the way expected by the project's sponsors?" (Morris & Hough, 1987). This is an owner measure, although secondary stakeholders may have different performance requirements, "which, if jeopardised, could seriously threaten the implementation of the projects." (Morris & Hough, 1987).

1. "Project management: Was the project implemented to budget, in schedule, to technical specification?" (Morris & Hough, 1987).
2. "Contractors' commercial performance: Did those who provided a service for the project benefit commercially (in either the short or long term)?" (Morris & Hough, 1987).
3. In case of cancellation: Was it "made on a reasonable basis and terminated efficiently?" (Morris & Hough, 1987). Projects may be "terminated on ill-conceived grounds when really they should be allowed to proceed." (Morris & Hough, 1987).

To Morris and Hough, a project may thus fail even if it is delivers in budget, to schedule and to technical specification, but fails for functionality reasons from the sponsor's, or even secondary stakeholders' point of view (Morris & Hough, 1987). On the other hand, a project that exceeds budget and schedule will not necessarily be considered a failure. The Concorde is an example of such a project (Morris & Hough, 1987). The construction of the Denver International Airport, and the Channel Tunnel are other examples (Kerzner, 2014b). On the other hand, "[...] many projects go ahead which, if evaluated properly, would have been terminated [...]" (Morris & Hough, 1987). In Sauer's words: "[...] systems can have all kinds of adverse outcomes yet not be described as failures. Systems can be delivered late, at inflated cost, with inadequate functionality, and may be largely unused, all without necessarily being failures. So long as the project organisation can command the resources and power to sustain its system, it will not be counted a failure because it is serving some organisational purposes." (Sauer, 1993).

Kerzner notes that "project failure is not necessarily the opposite of project success", and that failure and success come in shades of grey (Kerzner, 2014b). Sauer (1993, 1999) point out that the success and failure are used as evaluative terms about projects, implicitly making success and failure ex-post determinations. Additionally, projects may fail in some respects and succeed in others. Kusek points to another problem in viewing success and failure as complementary categories of the same domain by noting that success is a state, whereas failure is an event (Kusek et al., 2013). Kerzner further makes a distinction between "pre-implementation failure and post-implementation failure" (2014b), by which he means failure to deliver the expected project outputs (pre-implementation failure) and failure to deliver the expected outcomes (results, or benefits) from using the outputs in operation (post-implementation failure). PMI updated their text on project success in 2017: "Traditionally, the project management metrics of time, cost, scope and quality have been the most important factors in defining the success of a project. More recently, practitioners and scholars have determined that project success should also be measured with consideration toward achievement of the project objectives." (PMI, 2017).

Other research has highlighted the importance of critical activities at the front-end of projects (Dwivedi et al., 2015a; Dwivedi et al., 2015b; Edkins et al., 2013; Glass, 1999; Hall, Holt, & Purchase, 2003; Morris, 2011; Morris, 2009; Morris & Geraldi, 2011; Morris, 2013; Samset & Volden, 2016; Sauser et al., 2009; Serrador & Pinto, 2015; Williams & Samset, 2010; Williams, Samset, & Sunnevåg, 2009). The consequence the emphasis on front-end activities must be the possibility of *preconstruction* failure, or failure at the front-end.

3.4 Project failure as expectation failure

Lyytinen (1988); Lyytinen and Hirschheim (1987) claim that prior to their survey of the empirical literature on IT project failure, there had been "inadequate conceptual clarity of the IS failure notion" (Lyytinen, 1988), and that the notion of success was similarly "nebulous". Their study classifies IT project failure in four categories: 1) correspondence failure, i.e., failure to meet predefined design objectives, 2) process failure, i.e., failure to realise objectives within budget, 3) interaction failure, i.e., failure of the system to be used extensively enough by the intended users, and 4) expectation failure, i.e., failure to meet the expectations of stakeholders.

Expectation failure was Lyytinen and Hirschheim's proposal for a general definition of project failure, and it is in line with Bignell and Fortune (1984). Gilbreath (1986) reached a similar conclusion when defining project failure as unmet, reasonable expectation, and in characterizing project failure as a perception. Gilbreath further proposes to view this perceived failure as the "sum" of what he calls "actual failure" and "planning failure". This highlights that perceived failure may originate both in planning and in execution.

Sauer is critical of both the triple constraint view of failure and the expectation notion of failure (Sauer, 1993). Sauer maintains that some expectations are more reasonable than others (as does Gilbreath) and that it is sometimes by design that projects disappoint some stakeholders' expectations, and finally that some stakeholders are more powerful than others. Sauer's own view is that: "[T]ermination or abandonment is a necessary but not sufficient condition for failure." (Sauer, 1993). This commits Sauer to the view that a project is not a failure as long as the project organisation is sustained. But there seems to be a problem here, at least from a project sponsor perspective, because it would mean that no running project could be evaluated as a failure, regardless of cost, user-satisfaction, achievement of objectives or other such criteria of failure. As Gilbreath remarks: 'Some corporations drag the corpse of a project around long after it has lost viability" (Gilbreath, 1986). However, by pointing to failure as an evaluative term, Sauer's analysis highlights that it may be non-trivial, or maybe impossible, to assess a project definitively as a failure before it has ended, for example when the IT system produced by the project has been taken out of operation. Furthermore, Sauer's notion of project failure has the desirable feature of objectivity, i.e., it can be used to determine non-failure with minimal interpretational contribution.

Sauer is critical of Lyytinen and Hirshheim's notion of expectation failure, and he considers his own account "more forgiving" than expectation failure. But Sauer's account also makes failure contingent on stakeholder evaluations, and actions, so on that view, there seems to be no fundamental conflict between Sauer's view and the view of failure as expectation failure. It is doubtlessly a useful and informative insight that failing to meet stakeholder expecta- tions may lead to project failure, and that various stakeholders may have varying criteria for success and failure. But expectation failure, as the fundamental concept of failure may be critiqued from a different angle: Can we imagine projects that fail to meet the expectations of all stakeholders, but still deliver higher value compared to alternatives, and therefore are accepted to continue? Surely such projects may not be evaluated as unconditional successes, but it would be equally wrong to necessarily evaluate them as complete failures. If this is right, and if we want a notion of project failure that additionally contains a criterion for project termination, then here is a real problem for the expectation failure concept. Since we want to study project failure to prevent it in the future, we want a concept that can point out project failure, so that it might support efforts to recognise symptoms of failure *before* failure occurs, and preferably in time to prevent it, or even better, so that we can *design* the projects at the front-end in such a way that they have lower risk of failure.

Some authors note that a notion of failure based on stakeholder expectations makes failure a subjective rather than objective determination (Davis, 2014; Turner, 1999)[1]. We should probably take it that "subjective" here means contingent on a set of criteria particular to a given stakeholder group. But a more important question may be whether the stakeholders' expectations are legitimate and reasonable. If they are, they should at least in theory be predictable, and therefore it should be possible to have such expectations reflected in the objectives or constraints of the project.

It should further be observed that stakeholder expectations are not entirely exogenous fac- tors for the project; stakeholder management is generally appreciated as a project management activity concerned with both influencing and possibly adapting to stakeholder expectations. One important stakeholder group, not often mentioned, is software developers. An interesting study by Linberg (Glass, 1999; Linberg, 1999). claims that software developers have criteria for project failure that are completely separated from the triple constraint and independent of whether projects are completed or abandoned. Success from software developers' point of view has to do with the value of their own learning experience, according to Linberg.

The fact that stakeholders and project participants have different interests and preferences makes leading and managing projects no different from leading and managing any other organisation or business undertaking. If interests and preferences are irreconcilable, it may indeed be toxic for a project, and misalignment of expectations should be addressed by proper stakeholder management and people management within the project. But the fact that views and interests differ should not in itself prevent the realisation of positive results in professional environments.

The idea of expectation failure is an important insight highlighting that failing to meet expectations that are not formal requirements, or even unknown ex ante, may be a source of attribution of project failure.

3.5 Termination as project failure

According to Pinto and Mantel project failure "usually refers to a project that is terminated prior to completion." (Pinto & Mantel, 1990). To Ewusi-Mensah (2003) an abandoned project *is* a failed project. The Standish Group use the term *impaired* about projects that are eventually terminated. Boehm, like Sauer, finds that software project termination does not always imply failure: "[In] an era of rapid change, a lot of software projects are properly started, well managed, and properly terminated before completion because their original assumptions have changed" (Boehm, 2000). Boehm's view seems particularly relevant, if the changes of fundamental original assumptions could not have been known at the time of project planning, or if we are dealing with an experiment rather than a project.

We find it difficult to imagine situations, and we know of no empirical cases where termination before completion of a run-of-the mill commercial IT project - the focus of this paper - would *not* be considered a failure from an owner and sponsor perspective (Turner & Zolin, 2012), given that we take the project as unit of analysis. Terminating an IT project may still be the right thing to do, for example from a portfolio point of view, or because the sponsor wants to cut losses, or because a better way forward has been discovered. It is an easy concession to make that termination not always implies failure. But more importantly, the final definitive determination of a project as a success or failure is an ex-post evaluation that may consider unforeseen aspects of the project as a unique endeavour. What we are after here are the project performance criteria that are *generally* associated with ex-post attributions of IT projects as failures.

[1]Turner is, however, supportive of Morris' and Hough's measures of success (personal correspondence with Rodney Turner, August 2016).

Termination is not the only relevant criterion for project failure, but it is appealingly objective, in the sense that it can be determined ex post without interpretation whether or not a project has been terminated. Furthermore, taking the owner and sponsor perspective and the focus on run-of the mill commercial IT projects is clearly a matter of contextual choice, and other perspectives are, of course, legitimate, for example the perspectives of the end-user, project manager and contracting office (Dvir, Raz, & Shenhar, 2003), or the perspective of the software developer (Linberg, 1999).

4. Critical Review of Recent Literature on IT Project Failure and Gaps

The discussion of IT project performance criteria associated with ex-post attributions of failure can be traced back to 1970s, and it has not yet converged towards any generally agreed upon definition or unifying principle, and that is a gap in the literature.

The developments since 2010 in the research on IT project failure and success include Dalcher's (2014a) proposed distinction of levels of success. Like Bannermann's (2008) ideas of multiple levels of success: *Process, project management, product, business and strategic*, these developments can be traced back to Lyytinen and Hirschheim (1987) and Morris and Hough (1987). Pankratz and Basten (2013) have independently arrived at a concept of project failure that is strikingly similar to the dimensions presented by Morris and Hough (1987).

Serrador and Turner (2015) found an interesting correlation between "project efficiency" - roughly performance against the tripple constraint of budget, schedule and functionality (Cooke-Davies, 2002; Shenhar & Dvir, 2007) - and overall project success as perceived by stakeholders, which may bring back prominence to the classic performance criteria of the triple constraint. On the other hand, a comprehensive literature study on IT/IS project failure by Hughes et al. (2016) cautions against "failing to include any stakeholder aspects".

Moradi et al. (2020) have conducted an updated comprehensive liter- ature study of project performance criteria, but with a focus on project success. Baghizadeh et al. (2020) assess the literature on IT project failure, or more specifically the literature on information systems development project failure, which they divide in three major perspectives: rationalist, process and narrative. Baghizadeh, Cecez- Kecmanovic and Schlagwei acknowledge the literature's contributions to knowlege of IT project failure, and they do not propose new definitions of project failure. They offer a critique of the end-state focus of IT project failure research and propose a shift of focus "towards [information systems development] distress and the problematic situations experienced during [information systems development] projects." (Baghizadeh et al., 2020). This is a constructive proposal for extending the research agenda, and one that would also benefit from a clearer conceptualisation of the end-state to be avoided: the attribution of project failure, which is still lacking in the literature.

For our purposes, we find that strictly identifying IT project failure with termination is too restrictive, because a) we can easily imagine non-terminated projects that project owners will attribute with the classification of some degree of failure, and b) clearly not all failed projects are terminated (Gilbreath, 1986; Sauer, 1993).

The appealing idea of reducing all relevant project performance criteria to a matter of expectations may be possible, but we find it - for our purposes - not informative enough to reduce for example the tripple constraint and functionality to a matter of expectations. We therefore prefer to build on Morris & Hough's (1987) small set of "dimensions" of project failure. To avoid the conflation of performance in neutral terms (e.g., budget or schedule performance) with ex post value judgements, in casu "failure", we prefer to view the updated Morris & Hough "dimensions" not as failure criteria, but as performance criteria associated with stakeholders' attribution of "failure" to IT projects.

The gaps in the research literature thus remain: a) how should we define IT project failure in a comprehensive and authoritative way for run-of-the-mill commercial IT projects for the benefit of research and practice? in short: What is IT project failure? and b) why are failing IT projects not always terminated?

5. IT Project Failure, the Investment View

In this paper, we follow Morris (2013) in making *the project* the unit of analysis. We take the owner and sponsor point of view as main perspective, we take the operations phase into account, where the project can generate benefits, and we focus on run-of-the mill commercial IT projects. The Danish Government projects that we use as cases are explicitly expected to bring benefits in terms of efficiency improvements or quality improvements. In other words, we look upon the IT project as an *investment*. We treat project termination as a special case, since it can be determined objectively (i.e., with minimal interpretation) ex post if a project has been terminated or not. Furthermore, unlike other project performance criteria, e.g., budget performance, termination is a black and white distinction. In this section we present:

1. A set of performance criteria that stakeholders recurrently associated with the ex-post attribution of “failure” to IT projects of the type in focus in this paper.
2. A description of circumstances recurrently associated with project owners’ decision to terminate IT projects of the type in focus in this paper, and
3. a theory of IT project termination and *the marginal cost trap* mechanism that shows why the economic rationale for launching an IT project is different from the rationale for continuing an ongoing project.

5.1 IT project performance criteria associated with failure

We believe that the set of criteria presented in table 1 is comprehensive with respect to the triple-constraints views of project failure, Morris and Hough’s dimensions of project success, expectation failure, and that it can be used in a way that is consistent with Pinto, Sauer, and Ewusi-Mensah’s views of project failure that is contingent on termination. The proposed set of criteria is also consistent with contemporary definitions of project failure in the research literature, for example De Bruyne et al. (2021).

Table 1: Performance criteria associated with IT project failure

Project performance criteria associated with attribution of IT project failure
Shortfall of (one or more) performance criteria: *1. Benefits, financial or non-financial* *2. Functionality (in use)* *3. Meeting stakeholder expectations* *4. Meeting triple constraints:* *a) Budget* *b) Schedule* *c) Scope of delivery (content and quality)* *5. Contractor long term profitability* *6. Management of termination*

The criteria one through six above are based on Morris and Hough’s ”Dimensions of project success” (1987). Criteria one through three are included in Morris and Hough’s original first dimension (1987), and criterion one is more explicit in Morris’ later work (2013). We propose that shortfalls with respect to these criteria, or dimensions, of project performance comprehensively define how owners and sponsors are likely to evaluate the kind of IT projects in focus in this paper as project failures. This set of criteria therefore has predictive potential.

5.2 IT project termination

Why do sponsors not *always* terminate projects that fail, i.e., fall short of their objectives and constraints? An economically rational sponsor or owner would be expected to take an investment view, and require of an IT project that:

1. the benefits (financial or non-financial, long or short term) of the project are worth the cost of the project, and that
2. the project can deliver the benefits more cost-effectively than alternatives.

This is a general principle for e.g., government programs (Schuck, 2015). Additionally, it finds support in Turner’s theory of projects (Koskela & Howell, 2002; Turner, 2014), which states that the role of scope management is to ensure that: 1) “an adequate or sufficient amount of work is done”, 2) “unnecessary work is not done”, 3) “the work that is done delivers the stated business purpose”.

Sponsors allocate funding for IT projects to invest in expected beneficial outcomes (Holgeid et al., 2021; Morris, 2009). Benefits may or may not be measurable in purely financial terms, and in some cases benefits may be for example aesthetic, quality of life, or originate in political choice (Ackerman, 2004). Quantifiable or not, sponsors invest resources in projects in order to achieve benefits, so what is needed from a sponsor perspective is an idea of termination that has to do with the value of benefits, or outcomes (Morris, 2013).

Already incurred project cost in commercial IT projects are generally non-recoverable, in other words, sunk cost. This is because of a) the uniqueness of projects - unfinished customer specific IT project outputs are generally not re-deployable elsewhere - and b) the normally negligible cost of dismantling IT projects.

This means that in an ongoing project the value of expected benefits must justify the cost to *complete* the project rather than the *total* cost of the project. This shows that the rationale behind evaluating economic project performance is different *before* than *after* commitment-to- build. Before commitment-to-build, economic project performance should be evaluated based on expected *total* cost. After commitment-to-build, economic project performance should be evaluated based on *marginal* cost, when considering termination, redefinition, or revision of baseline.

According to the investment view, which in our view follows from taking the project sponsor perspective, *IT project termination* may thus be associated with the situation where the value of completing the project is negative or unfavourable, see table 2.

Table 2: IT project termination - general criterion

IT project termination - general criterion
The value of benefits (quantifiable or non-quantifiable) does not justify the cost to complete the project, or a more cost-effective alternative is available.

Value of benefits may be financial or non-financial. In cases where benefits are un- quantifiable, the logic still applies: Sponsors may have accepted a project that promises non-quantifiable value *V* at cost *C* by some satisficing or strategic consideration. It does not follow, however, that sponsors can be expected to accept *V* at a cost of *Cx, x*>1.

Furthermore, increased cost may tip the balance in favour of alternative investments for providing *V,* hence the relevance of the cost-effectiveness consideration. Constraints may include legal, technical feasibility, organisational, financial, policy, and ethical constraints. Relevant alternatives may include project termination, redefining or replanning the project. Using this compound performance criterion associated with attribution of failure, we will distinguish between the following:

1. *IT project performance shortfalls*: The project is completed, but has shortfalls with respect to benefits, functionality, stakeholder expectations, triple constraints, long term contractor profitability and or management of termination. The concern for contractor profitability in project management may seem at odds with the owner perspective from a narrow shareholder value point of view. Less so, from the perspective of socially responsible owners. More generally, projects may consume resources that are not included in project accounts, e.g., contractor cost. Similarly, projects may produce benefits beyond what is considered in the scope of the project itself. From a global point of view, such extra ressource consumption and benefits should ideally be taken into consideration. This may, however, be unrealistic from a practical point of view.
2. *IT project termination*: The project is terminated because the expected value of benefits does not justify the cost to complete the project, or because more cost-effective alternatives are available.

This concept of IT project termination is a theoretical (Sutton & Staw, 1995; Weick, 1995) and normative notion, in the sense that is prescribes when projects *should* be considered for termination, and it therefore has predictive potential. It is also empirically valid, in the sense that it explains cases of actual IT project terminations, as we shall demonstrate below with the case summaries of three major terminated government IT projects in Denmark.

5.3 Theory of IT project termination and the marginal cost trap mechanism

The marginal cost trap helps explain why it is not always rational to terminate projects, even when project cost exceeds budgets. This in turn helps explain why a rational criterion for project termination is not trivially linked to the triple constraint based on total cost, and why therefore a separate criterion for project termination, is warranted.

Consider an imaginary 12-month IT project with planned benefits worth €18m and planned cost of €12m. When the project starts (month zero) it is planned to generate a net value of benefits (Net Value) of €6m.

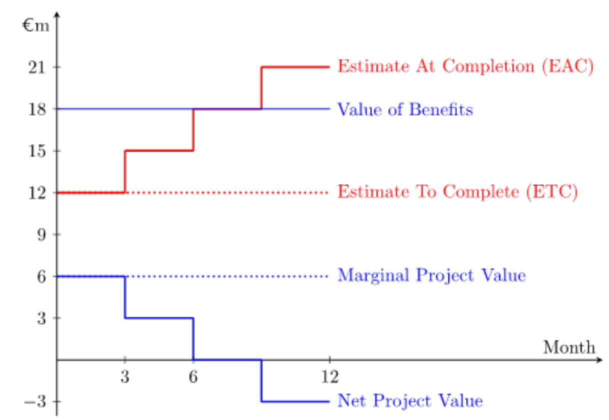

Figure 1: Marginal Cost Trap

After three months, the project has spent €3m, and the project manager or the contractor estimates that the project cost (EAC[2]: Estimate at Completion) will increase from €12m to [2]EAC (Estimate at Completion) is the estimated or re-estimated total cost of completing the project. ETC (Estimate to Complete) is the estimated or re-estimated cost to to complete the project. EAC and ETC project management terms and concepts used in the "earned value" concept, and in project accounting under Percentage of Completion Accounting regimes. €15m, so that now (at month three) the cost to *complete* the project will be €12m (the total cost of 15m less the 3m spent in the first three months).

The cost spent in the first three months is non-recoverable, i.e., sunk cost, so rational economic analysis says that the project should continue, because the value of the benefits still justifies the cost to complete the project (ETC[2]: Estimate to Complete), in fact, with the same net marginal value of benefits (Marginal Net Value) as the original plan (€18m - €12m). Imagine further a similar situation after six and nine months in the project, see figure 1.

The project has now fallen into *the marginal cost trap*, which has led to the continuation of a project that has turned out to be unattractive. If, however, at any time during the project the cost *to complete* the project should be estimated to exceed the value of the benefits of the project, then the project should be terminated. In this case the project owner must steer clear of another trap: The sunk cost fallacy, or escalation of commitment (Arkes & Blumer, 1985; Duxbury, 2012; Flyvbjerg, 2021; Garland & Newport, 1991; Gunia, Sivanathan, & Galinsky, 2009; Heath, 1995; Kahneman & Tversky, 1979, 2000; Keasey & Moon, 2000; Sharp & Salter, 1997; Tan & Yates, 1995; Westfall, Jasper, & Christman, 2012; Zeelenberg & Van Dijk, 1997). The sunk cost fallacy is what makes project owners reluctant to terminate projects they have already invested in; even in cases where doing so would be economically sound. For the individual project decision maker, on the other hand, it may be a different matter: Economic analysis of the future benefits of projects may be complex, and information not readily available or transparent, so rational analysis may be bounded (Kahneman, 2003; Simon, Egidi, & Viale, 2008). Furthermore, when large projects get into trouble, the accountability for writing off sunk cost may land heavily on the shoulders of individual decision makers (Brockner, 1992; Harrison & Harrell, 1993; Jensen & Meckling, 1976; Kanodia, Bushman, & Dickhaut, 1989; Sharp & Salter, 1997). This may lead to overoptimistic and irrational expectations for the future performance of ailing projects, so that they are allowed to continue rather than be terminated. Hence the "stickiness" of IT projects.

An implication of this condition of project ownership is that in some ongoing projects with incremental cost escalation, there may be no point in time where it is rational to terminate the project, even though it can be foreseen that the project will never be worth the original investment. The project in figure 1 will likely be considered unsuccessful, but based on purely rational economic analysis, it should not be terminated. In the practical project world, the project owner will probably, and for good reason, at some point loose confidence in the project, or the contractor's ability to deliver it, and then terminate or reconfigure the project.

In many cases, some value - for example valuable learnings, or re-deployable modules - can be recovered from failed projects, see for example Yeow and Chua (2020). But psychological rationalisations after the fact, e.g., hindsight bias and other biases (Flyvbjerg, 2021) may be deceptive, and may overshadow the assessment that in hindsight, we would have been better off by not undertaking the project in the first place.

IT project work is difficult, and actions that we in hindsight would have wanted differently are inevitable. In fact, exaggerated risk aversion can probably hinder progress, or be too costly. The fruitful potential of hindsight and ex post analysis is not criticising the past but improving the future.

Ways to mitigate the risk of falling into the marginal cost trap include a) better project preparation and planning - including better feasibility studies and contingency provisions, b) incremental approaches, for example agile, where project outputs are implemented continuously and the value of benefits assessed incrementally, and c) removing experiments from the project execution phase, for example by using prototyping, proof of concepts, and small scale technology assessment at the front-end, and before commitment-to-build in order to remove knowable unknowns from the project execution phase.

6. Cases of IT projects evaluated as failures

In this section we will apply the proposed concept and definitions of IT project failure to five Danish government IT projects with more than €30m in project spending that have been evaluated as failures by project sponsors and major stakeholders from 2010 to 2015. These example cases will be used as plausibility probes (George & Bennett, 2005; Levy, 2008) for the presented set of IT project performance criteria associated with ex-post attributions of project failure, and for the theoretical predictability of IT project termination. The five projects considered by stakeholders as failures of varying degree include two completed, and three terminated IT projects.

6.1 IT projects evaluated as failures

The two projects analysed in table 3 are examples of Danish government IT projects, which stakeholders have evaluated as failures. The evaluations of these projects as failures, however, are not uncontentious. Furthermore, both projects have produced systems, which are now in operation, providing functionality, and delivering benefits.

Table 3: Cases of IT projects evaluated as failures (Rigsrevisionen, 2010, 2011)

Case	Performance shortfalls
eTL	**Functionality:** First year of operation caused delays and added significant costs for some citizens and organisations **Budget:** Extension by 25% **Schedule:** 17-, 34-, and 36-month delays of the three main deliveries **Stakeholders:** Citizens sued the government for damages
Rejsekortet	**Functionality:** Unsatisfactory usability of the system **Budget:** Main construction cost overruns were covered by the contractor, increased operational cost **Schedule:** Four to six years delay **Stakeholders:** Severe and continuous criticism by citizens and politicians after implementation

The performance criteria listed for the projects in table 3 is a subset of the presented general set of IT project performance associated with attributions of failure in table 1. The National Auditor reports contain additional topics, including criticisms of the processes used to manage the projects. However, the criteria in table 3 list the observable shortfalls of the projects, without which it is unlikely that the projects would have been evaluated as failures and consequently audited by the Danish National Auditor. Our proposed concept of IT project failure is consistent with The National Auditor's evaluation of these projects.

6.2 IT project terminations

The Danish central government terminated three major IT projects in the period from 2012 to 2015, see table 4. In all three cases, the projects went through a process of multiple delays and requests for budget extensions, which led the government to initiate external project reviews. In all the three cases of project termination, the external reviews found that project recovery would not be economically feasible. The justifications for terminating the projects are consistent with the criterion of the concept of IT project termination presented in 2.

Table 4: Cases of IT project termination

Case	Justification for IT project termination
POLSAG	A committee appointed by the government to review the project found that the project represented an **"unsatisfactory business case: It would be time consuming, resource demanding and costly to solve the problems** with the system. It would be 'throwing good money after bad' [...] **Given the cost, the net value of the benefits would be very limited."** (Rigsrevisionen, 2013).
PROASK	At the end of a delayed software development phase, and prior to taking the IT system into production, concerns were raised that the planning assumption of staff reductions enabled by the new IT system would not hold. External consultants were commissioned to review the situation, and they concluded that rather than enabling staff reductions, the new IT system would require additional staff. The consultants reconstructed the business case for the project and concluded that **the net present value over eight years of taking the new system into operation would be €57m higher than continuing operation of the existing IT system**, and that operational cost of using the new IT system would be from 34% to 58% higher that operational cost of using the existing system.
EFI	A government commissioned external review concluded that **it would not be economically viable and not technically feasible to correct the system** i.e., it could not, within reasonable constraints, be brought to a well-functioning state, where it would generate value (Accenture, 2015a, 2015b, 2015c, 2015d, 2015e; Kammeradvokaten, 2015).

7. Summary and Conclusions

In this paper, we have accounted for the soundness of studying past IT project failure in order to prevent future IT project failure with a focus on run-of-the-mill commercial IT project from which owners expect tangible or non-tangible benefits. We have reviewed the academic and professional literature's varying definitions of IT project failure and presented a unifying concept that defines a set of general IT project performance criteria observed in plausibility probing case studies to be associated with the evaluation of IT projects as failures. The definition presented allows a distinction between a neutral domain of project performance and a value domain, where stakeholders in some cases may attribute the evaluation of "failure" to IT projects. The IT project performance criteria found associated with IT project failure are: *Shortfall of: Financial or non-financial benefits, functionality, meeting stakeholder expectations, meeting triple constraints (budget, schedule, scope of delivery), long term contractor profitability, and management of termination.*

We have presented a separate criterion and theory for the special case of IT project termination, based on an investment view of projects, and a sponsor and owner perspective. An IT project can be expected to be terminated if: *The value of benefits (quantifiable or non-quantifiable) does not justify the cost to complete the project, or a more cost-effective alternative is available.* Incurred cost is continuously written off as sunk cost, and alternatives may include termination, redefinition, or re-baselining of the project. In other words, once commitment-to-build has been made, benefits should justify the cost to *complete* the project, rather than the *total* cost of the project. This explains the "stickiness" of on-going IT projects and highlights the critical nature of commitment-to-build decisions. We have presented the *the marginal cost trap* mechanism to explain why not all projects with shortfall of objectives are, or should be, terminated. The theory of IT project termination explains rational criteria for IT project termination, and we have shown that the termination of significant government IT projects in Denmark is consistent with the theory.

7.1 Practical implications

The definition of IT project failure presented includes performance criteria that are useful for risk assessment of projects a) at the front end, i.e., before commitment-to-build, b) at major milestones, and c) when baseline revisions are made. Identified risks can be cross-checked and qualified by the the full set of project performance criteria shown to be associated with attributions of project failure, not just the criteria of the triple constraint. Additionally, if some of the standard project performance criteria are less important in a given project, for example schedule, or the opinions of certain stakeholders, this can be made explicit in the project charter.

The theory of IT project termination can be useful to practitioners because it can help mitigate the effects of undesirable escalation of commitment in ongoing projects, and because the theory sets rational boundaries for budget extensions, when baselines are reset, which is frequent in IT projects. In this way, the presented concept of IT project termination can support unbiased decisions to terminate unviable IT projects to reduce losses caused by shortfalls in project performance, or conversely, support the continuation of projects where the cost to complete the project is justified by expected benefits.

The marginal cost trap mechanism explains the importance of the original project budget in a domain where it is not rare that actual project cost close at multiples of the original budget. Furthermore, *the marginal cost trap* highlights the importance of commitment-to-build as a critical moment, where the basis for economic project evaluation changes from total cost to marginal cost.

Ways to mitigate the risk of falling into the marginal cost trap include a) better project preparation and planning - including better feasibility studies and adequate risk contin- gency provisions, b) incremental approaches, for example agile, where project outputs are implemented continuously and the value of benefits assessed incrementally, and c) removing experiments from the project execution phase, for example using prototyping, proof of con- cepts, and technology assessment at the front-end, and before commitment-to-build in order to remove knowable unknowns from the project execution phase.

8. Acknowledgements

We are grateful to Peter Morris, Peter Sestoft, Bent Flyvbjerg, Cecil Chua, and the anonymous reviewers of *The Journal of Modern Project Mangement* for their comments and suggested improvements to previous versions of this paper.

9. Full Disclosure

The author was from 2010 to 2013 employed in a senior executive role by the main contractor for two of the five IT projects in section 6, and directly involved in the projects. The research behind the current paper is co-funded by the Danish Ministry of Finance. The author is a member of two Danish government oversight committees that review major IT projects, but none of the projects mentioned in the article. These facts are stated as a formality, they do not constitute conflicts of interest.

10. Research Limitations and Future Research Rirections

10.1 Research Limitations

There are other possible explanations of the "stickines" of IT projects than *the marginal cost trap* presented in this paper, including explanations based on strong theory from behavioural science, for example the sunk cost fallacy, or escalation of commitment (Arkes & Blumer, 1985; Duxbury, 2012; Garland & Newport, 1991; Gunia et al., 2009; Heath, 1995; Kahneman & Tversky, 1979, 2000; Keasey & Moon, 2000; Sharp & Salter, 1997; Tan & Yates, 1995; Westfall et al., 2012; Zeelenberg & Van Dijk, 1997). For a comprehensive overview, see for example Flyvbjerg (2021). We consider *the marginal cost trap* presented in this paper as a complementary explanation rather than a rival alternative, since explanations rooted in behavioural sciences may well have rational elements.

The focus of this paper is run-of-the-mill commercial IT projects, and the relevance, validity and applicability of the findings beyond this scope have not been investigated. Some respectable academics are opposed to defining IT project failure in terms of economic performance, and they argue that for example the learning of the project organisation, or the applicability of work done in other contexts must also be considered. From that point of view, the analysis in this paper may seem incomplete. However, for the type of IT project in focus, economic performance - in a wide sense - it the major criterion for failure.

The theory of *the marginal cost trap* is based on a small number of cases of Danish government IT projects, and even though the rationale is based on generally accepted investment concepts, the study would benefit from cases of IT projects in other sectors and regions.

10.2 Future Research Directions

The definition of IT project failure and failure criteria presented is a compact synthesis of the definitions and criteria found in the literature, which will allow our ongoing research in IT project failure to be explicit, specific, and well-defined with respect to the object of study. The reference definition of IT project failure presented is a respectful update of Morris and Hough's milestone definition from 1987 based on Morris' own later work, and on the reviewed literature that we have found relevant for the project type in focus in this paper: run-of-the-mill commercial IT projects.

The separation of the assessment of IT project performance in neutral terms from the value domain of ex-post attributions of "failure" will be helpful for case studies and project postmortems, because it will support the factual assessments of performance without de- motivating project participants by using the stigmatising, derogative and contentious term "failure".

We hope that the rational theory of IT project termination and the *marginal cost trap* mechanism presented here will be used, discussed, and critiqued by academics and practitioners with an interest in the type of IT project in focus here.

We will in future research seek to apply the results of the work in this paper: The definition of IT project failure and the marginal cost trap to other types of IT projects than the ones used in this paper: Danish Government IT projects.

References

Abdel-Hamid, T. K., & Madnick, S. E. (1990). The Elusive Silver Lining: How We Fail to Learn from Software Development Failures. *MIT Sloan Management Review, 32*(1), 39. https://www.proquest.com/openview/3a5c12fe4ca9e8c484744a550eebf004

Accenture. (2015a). *Data Migration Assessment*. Technical Report Danish Tax. https://www.skm.dk/media/6320/accenture-data-migration-assessment.pdf

Accenture. (2015b). *Functional Analysis*. Technical Report Danish Tax. https://www.skm.dk/media/6319/accenture-functional-analysis.pdf

Accenture. (2015c). *Overlay Report - Assistance for analysis of "Et fælles inddrivelsessystem"*. Technical Report Danish Tax. https://www.skm.dk/media/6317/accenture-overlay-report.pdf

Accenture. (2015d). *Programme, Project & Service Management Analysis*. Technical Report Danish Tax. https://www.skm.dk/media/6321/accenture-ppsm-analysis.pdf

Accenture. (2015e). *Technical Analysis*. Technical Report Danish Tax. https://www.moneycontrol.com/us-markets/technical-analysis/accenture/ACN/daily

Ackerman, F. (2004). *Priceless: On knowing the price of everything and the value of nothing*. The New Press. https://works.swarthmore.edu/alum-books/3787

Agarwal, N., & Rathod, U. (2006). Defining 'success' for software projects: An exploratory revelation. *International journal of project management, 24*(4), 358-370. https://doi.org/10.1016/j.ijproman.2005.11.009

APM. (2005). *APM Body of Knowledge Definitions* (5th ed.). Technical Report Association for Project Management. https://www.apm.org.uk/media/1605/final-proof-bok-6-definitions.pdf

Arkes, H. R., & Blumer, C. (1985). The psychology of sunk cost. *Organizational behavior and human decision processes, 35*(1), 124-140. https://doi.org/10.1016/0749-5978(85)90049-4

Artto, K. A., & Wikström, K. (2005). What is project business? *International journal of project management, 23*(5), 343-353. https://doi.org/10.1016/j.ijproman.2005.03.005

Baghizadeh, Z., Cecez-Kecmanovic, D., & Schlagwein, D. (2020). Review and critique of the information systems development project failure literature: An argument for exploring information systems development project distress. *Journal of Information Technology, 35*(2), 123-142. https://doi.org/10.1177/0268396219832010

Baker, B. N., Murphy, D. C., & Fisher, D. (1983). Factors affecting project success. In D. I. Cleland & W. R. King (Eds.), *Project Management Handbook* (pp. 902–919). New York: Van Nostrand Reinhold. https://doi.org/10.1002/9780470172353.CH35

Bannerman, P. L. (2008). Defining project success: A multi-level framework. In *PMI Research Conference* (pp. 1–13). PMI. https://www.pmi.org/learning/library/defining-project-success-multilevel-framework-7096

Bhaskar, R. (2008). *A Realist Theory of Science*. Routledge. https://doi.org/10.4324/9780203090732

Bhaskar, R., & Hartwig, M. (2016). *Enlightened common sense: The philosophy of critical realism*. Routledge. https://doi.org/10.4324/9781315542942

Bignell, V., & Fortune, J. (1984). *Understanding Systems Failure*. Manchester University Press. https://www.abebooks.com/products/isbn/9780719009730

Boddie, J. (1987). The project postmortem. *Computerworld, 21*(49), 77-82.

Boehm, B. (2000). Project termination doesn't equal project failure. *Computer, 33*(9), 94-96. https://doi.org/10.1109/2.868706

Boell, S. K., & Cecez-Kecmanovic, D. (2014). A hermeneutic approach for conducting literature reviews and literature searches. *Communications of the Association for information Systems, 34*(1), 12. https://doi.org/10.17705/1CAIS.03412

Brockner, J. (1992). The escalation of commitment to a failing course of action: Toward theoretical progress. *Academy of management Review, 17*(1), 39-61. https://doi.org/10.5465/amr.1992.4279568

Brown, T. (2001). Modernisation or failure? IT development projects in the UK public sector. *Financial Accountability & Management, 17*(4), 363-381. https://doi.org/10.1111/1468-0408.00139

Budzier, A. (2014). *Theorizing outliers: explaining variation in IT project performance.* (Doctoral dissertation). Oxford University, UK. https://ora.ox.ac.uk/objects/uuid:9fd44230-32a0-41f0-861e-4ef999aea22f

Cadle, J., & Yeates, D. (2007). *Project Management for Information Systems* (5th ed.). Prentice Hall. https://dl.acm.org/doi/abs/10.5555/1557176

Carlsson, S. A. (2011). Critical realist information systems research in action. In *Researching the future in information systems* (pp. 269-284). Springer. https://doi.org/10.1007/978-3-642-21364-9_17

Chua, A. Y. (2009). Exhuming IT projects from their graves: An analysis of eight failure cases and their risk factors. *Journal of Computer Information Systems, 49*(3), 31-39. https://www.tandfonline.com/doi/abs/10.1080/08874417.2009.11645321

Cole, A. (1995). Runaway projects: cause and effects. *Software World, 26*(3), 3-5. https://liucs.net/cs633f11/glass-runaways.pdf

Collier, B., DeMarco, T., & Fearey, P. (1996). A defined process for project post mortem review. *IEEE software, 13*(4), 65-72. https://doi.org/10.1109/52.526833

Collier, D. (1999). Data, field Work, and extracting new ideas at close range. *Newsletter of the Organized Section in Comparative Politics of the American Political Science Association, 10*(1), 1-6. https://ssrn.com/abstract=1757215

Cooke-Davies, T. (2002). The "real" success factors on projects. *International journal of project management, 20*(3), 185-190. https://doi.org/10.1016/S0263-7863(01)00067-9

Dalcher, D. (1994). Falling down is still part of growing up-success, failure and forensic ECBS. In *Proceedings 1994 Tutorial and Workshop on Systems Engineering of Computer-Based Systems* (pp. 159-162). IEEE. https://doi.org/10.1109/ECBS.1994.331671

Dalcher, D. (2010). The las story: learning from project failure. In J. R. Turner, M. Huemann, F. T. Anbari, & C. N. BredilletBredillet (Eds.), *Project Perspectives chapter 13* (pp. 296–317). Routeledge. https://project-management.com/7-lessons-to-learn-from-a-failed-project/

Dalcher, D. (2014a). *Advances in Project Management: Narrated Journeys in Unchartered Territory*. Routeledge. https://eprints.lancs.ac.uk/id/eprint/131341

Dalcher, D. (2014b). Rethinking success in software projects: looking beyond the failure factors. In *Software project management in a changing world* (pp. 27-49). Springer. https://doi.org/10.1007/978-3-642-55035-5_2

Davis, K. (2014). Different stakeholder groups and their perceptions of project success. *International journal of project management, 32*(2), 189-201. https://doi.org/10.1016/j.ijproman.2013.02.006

De Bruyne, M.-J., Moens, E., & Vanhoucke, M. (2021). Project recovery: Project failures and how to get rid of them. *Journal of Modern Project Management, 9*(1), 155-169. http://dx.doi.org/10.19255/JMPM02611

De Wit, A. (1988). Measurement of project success. *International journal of project management, 6*(3), 164-170. https://doi.org/10.1016/0263-7863(88)90043-9

Duxbury, D. (2012). Sunk costs and sunk benefits: A re-examination of re-investment decisions. *The British Accounting Review, 44*(3), 144-156. https://doi.org/10.1016/j.bar.2012.07.004

Dvir, D., Raz, T., & Shenhar, A. J. (2003). An empirical analysis of the relationship between project planning and project success. *International journal of project management, 21*(2), 89-95. https://doi.org/10.1016/S0263-7863(02)00012-1

Dwivedi, Y. K., Wastell, D., Henriksen, H. Z., & De, R. (2015a). Guest editorial: Grand successes and failures in IT: Private and public sectors. *Information Systems Frontiers, 17*(1), 11-14. https://doi.org/10.1007/s10796-014-9543-0

Dwivedi, Y. K., Wastell, D., Laumer, S., Henriksen, H. Z., Myers, M. D., Bunker, D., Elbanna, A., Ravishankar, M., & Srivastava, S. C. (2015b). Research on information systems failures and successes: Status update and future directions. *Information Systems Frontiers, 17*(1), 143-157. https://doi.org/10.1007/s10796-014-9500-y

Edkins, A., Geraldi, J., Morris, P., & Smith, A. (2013). Exploring the front-end of project management. *Engineering project organization journal, 3*(2), 71-85. https://doi.org/10.1080/21573727.2013.775942

Ewusi-Mensah, K. (2003). Software Development Failures. https://mitpress.mit.edu/9780262050722/software-development-failures/

Fincham, R. (2002). Narratives of success and failure in systems development. *British Journal of Management, 13*(1), 1-14. https://doi.org/10.1111/1467-8551.00219

Flowers, S. (1996). *Software Failure: Management Failure*. John Wiley & Sons. https://dl.acm.org/doi/abs/10.5555/261187

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative inquiry, 12*(2), 219-245. https://doi.org/10.1177/1077800405284363

Flyvbjerg, B. (2021). Top ten behavioral biases in project management: An overview. *Project management journal, 52*(6), 531-546. https://doi.org/10.1177/87569728211049046

Flyvbjerg, B., Ansar, A., Budzier, A., Buhl, S., Cantarelli, C., Garbuio, M., Glenting, C., Holm, M. S., Lovallo, D., & Lunn, D. (2018). Five things you should know about cost overrun. *Transportation Research Part A: Policy and Practice, 118*, 174-190. https://doi.org/10.1016/j.tra.2018.07.013

Flyvbjerg, B., & Gardner, D. (2023). *How Big Things Get Done: The Surprising Factors that Determine the Fate of Every Project from Home Renovations to Space Exploration, and Everything in Between*. Penguin Random House. https://www.penguinrandomhouse.com/books/672118

Fortune, J., & Peters, G. (1995). *Learning from Failure the Systems Approach*. John Wiley & Sons. https://www.wiley.com/en-ie/Learning+From+Failure:+The+Systems+Approach-p-9780470865620

Fortune, J., & Peters, G. (2005). *Information systems: Achieving Success by Avoiding Failure* (2nd ed.). Wiley. https://www.wiley.com/en-pk/Information+Systems%3A+Achieving+Success+by+Avoiding+Failure-p-9780470862568

Fortune, J., & White, D. (2006). Framing of project critical success factors by a systems model. *International journal of project management, 24*(1), 53-65. https://doi.org/10.1016/j.ijproman.2005.07.004

Garland, H., & Newport, S. (1991). Effects of absolute and relative sunk costs on the decision to persist with a course of action. *Organizational behavior and human decision processes, 48*(1), 55-69. https://doi.org/10.1016/0749-5978(91)90005-E

Gauld, R. (2007). Public sector information system project failures: Lessons from a New Zealand hospital organization. *Government information quarterly, 24*(1), 102-114. https://doi.org/10.1016/j.giq.2006.02.010

George, A. L., & Bennett, A. (2005). *Case Studies and Theory Development in the Social Sciences*. MIT Press. https://mitpress.mit.edu/9780262572224/case-studies-and-theory-development-in-the-social-sciences/

Gilbreath, R. D. (1986). *Winning at Project Management: What Works, What Fails and Why*. Wiley. https://www.abebooks.com/first-edition/Winning-Project-Management-What-Works-Fails/243040760/bd

Glass, R. L. (1998). *Software Runaways: Lessons Learned from Massive Software Project Failures* (1st ed.). Prentice Hall. https://worldcat.org/en/title/312689668

Glass, R. L. (1999). Evolving a new theory of project success. *Communications of the ACM, 42*(11), 17-19. https://dl.acm.org/doi/fullHtml/10.1145/319382.319385

Gunia, B. C., Sivanathan, N., & Galinsky, A. D. (2009). Vicarious entrapment: Your sunk costs, my escalation of commitment. *Journal of Experimental Social Psychology, 45*(6), 1238-1244. https://doi.org/10.1016/j.jesp.2009.07.004

Hall, M., Holt, R., & Purchase, D. (2003). Project sponsors under New Public Management: lessons from the frontline. *International journal of project management, 21*(7), 495-502. https://doi.org/10.1016/S0263-7863(02)00054-6

Harrison, P. D., & Harrell, A. (1993). Impact of "adverse selection" on managers' project evaluation decisions. *Academy of Management Journal, 36*(3), 635-643. https://doi.org/10.5465/256596

Heath, C. (1995). Escalation and de-escalation of commitment in response to sunk costs: The role of budgeting in mental accounting. *Organizational behavior and human decision processes, 62*(1), 38-54. https://doi.org/10.1006/obhd.1995.1029

Hoddy, E. T. (2019). Critical realism in empirical research: employing techniques from grounded theory methodology. *International Journal of Social Research Methodology, 22*(1), 111-124. https://doi.org/10.1080/13645579.2018.1503400

Holgeid, K. K., Jørgensen, M., Sjøberg, D. I., & Krogstie, J. (2021). Benefits management in software development: A systematic review of empirical studies. *IET Software, 15*(1), 1-24. https://doi.org/10.1049/sfw2.12007

Huang Chua, C. E., & Myers, M. D. (2018). Social control in information systems development: a negotiated order perspective. *Journal of Information Technology, 33*(3), 173-187. https://doi.org/10.1057/s41265-017-0048-4

Hughes, D. L., Dwivendi, Y. K., Simintiras, A. C., & Rana, N. P. (2016). *Success and Failure of IS/IT Projects - A State of the Art Analysis and Future Directions*. Springer. https://doi.org/10.1007/978-3-319-23000-9

Ika, L. A. (2009). Project success as a topic in project management journals. *Project management journal, 40*(4), 6-19. https://doi.org/10.1002/pmj.20137

IPMA. (2006). *ICB - IPMA Competence Baseline, version 3.0*. Technical Report International Project Management Association. https://worldcat.org/title/244796690

Jensen, M. C., & Meckling, W. H. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics, 3*(4), 305-360. https://edisciplinas.usp.br/pluginfile.php/4966127/mod_resource/content/1/SSRN-id94043.pdf

Johnson, J. (1995). Chaos: The dollar drain of IT project failures. In *Application development trends* (pp. 41-47). https://cir.nii.ac.jp/crid/1570291226052375552

Jones, C. (1995). Patterns of large software systems: failure and success. *Computer, 28*(3), 86-87. https://doi.org/10.1109/2.366170

Jones, C. (1996). *Software Systems Failure and Success*. Thomson Computer Press.

Kahneman, D. (2003). Maps of bounded rationality: Psychology for behavioral economics. *American economic review, 93*(5), 1449-1475. https://doi.org/10.1257/000282803322655392

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*, 263–291. https://www.jstor.org/stable/1914185

Kahneman, D., & Tversky, A. (2000). *Choices, Values and Frames*. Cambridge University Press. https://doi.org/10.1017/CBO9780511803475

Kammeradvokaten. (2015). *Rapport om legalitetsanalyse af EFI-delsystem-funktionaliteter, Lønindeholdelse, Tvungne Betalingsordninger, og Betalingsevneberegning Budget*. Technical Report Legal Advisor to the Danish Government for Danish Tax. https://www.skm.dk/media/6316/kammeradvokatens-legalitetsanalyse.pdf

Kanodia, C., Bushman, R., & Dickhaut, J. (1989). Escalation errors and the sunk cost effect: An explanation based on reputation and information asymmetries. *Journal of Accounting research, 27*(1), 59-77. https://doi.org/10.2307/2491207

Keasey, K., & Moon, P. (2000). Sunk cost effects: a test of the importance of context. *Economics letters, 66*(1), 55-58. https://doi.org/10.1016/S0165-1765(99)00179-2

Keil, M., Tan, B. C., Wei, K.-K., Saarinen, T., Tuunainen, V., & Wassenaar, A. (2000). A cross-cultural study on escalation of commitment behavior in software projects. *MIS quarterly, 24*(2), 299-325. https://doi.org/10.2307/3250940

Kerth, H. (2001). *Project Retrospectives: A handbook for Team Reviews*. Dorset House Publishing. http://www.dorsethouse.com/books/prindex.html

Kerzner, H. R. (2013). *Project Management. A Systems Approach to Planning, Scheduling, and Controlling* (11th ed.). Wiley. https://worldcat.org/en/title/809250664

Kerzner, H. R. (2014a). *Project Management Best Practices Achieving Global Excellence* (3rd ed.). Wiley. https://www.wiley.com/en-gb/Project+Management+Best+Practices:+Achieving+Global+Excellence,+3rd+Edition-p-9781118835531

Kerzner, H. R. (2014b). *Project Recovery: Case Studies and Techniques for Overcoming Project Failure*. John Wiley & Sons. https://www.wiley.com/en-gb/Project+Recovery:+Case+Studies+and+Techniques+for+Overcoming+Project+Failure-p-9781118809198

Koskela, L. J., & Howell, G. (2002). The underlying theory of project management is obsolete. In *Proceedings of the PMI research conference* (pp. 293-302). PMI. http://eprints.epwp.eprints-hosting.org/id/eprint/75

Kusek, J. Z., Pestidge, M. G., & Hamilton, B. C. (2013). Fail-Safe Management: Five Rules to Avoid Project Failure. https://openknowledge.worldbank.org/handle/10986/15770

Levy, J. S. (2008). Case studies: Types, designs, and logics of inference. *Conflict management and peace science, 25*(1), 1-18. https://www.tandfonline.com/doi/abs/10.1080/07388940701860318

Linberg, K. R. (1999). Software developer perceptions about software project failure: a case study. *Journal of Systems and Software, 49*(2-3), 177-192. https://doi.org/10.1016/S0164-1212(99)00094-1

Lipton, P. (2001). Inference to the best explanation. In W. Newton-Smith (Ed.), *A Companion to the Philosophy of Science* (pp. 184–193). Blackwell. https://doi.org/10.1002/9781405164481.ch29

Lucas, H. (1975). *Why Informations Systems Fail*. Columbia University Press. https://doi.org/10.7312/luca94612

Lyytinen, K. (1988). Expectation failure concept and systems analysts' view of information system failures: Results of an exploratory study. *Information & Management, 14*(1), 45-56. https://doi.org/10.1016/0378-7206(88)90066-3

Lyytinen, K., & Hirschheim, R. (1987). Information systems failures: a survey and classification of the empirical literature. *Oxford Surveys in Information Technology, 4*, 257–309. https://dl.acm.org/doi/abs/10.5555/54890.54898

McManus, J., & Wood-Harper, T. (2008). *A study in project failure*. Technical Report BSC, The Chartered Institute for IT. https://www.bcs.org/articles-opinion-and-research/a-study-in-project-failure/

Mingers, J. (2000). The contribution of critical realism as an underpinning philosophy for OR/MS and systems. *Journal of the Operational Research Society, 51*(11), 1256-1270. https://doi.org/10.1057/palgrave.jors.2601033

Mingers, J. (2004). Re-establishing the real: critical realism and information systems. In *Social theory and philosophy for information systems* (pp. 372-406). Wiley. http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0470851171.html

Mingers, J., Mutch, A., & Willcocks, L. (2013). Critical realism in information systems research. *MIS quarterly, 37*(3), 795-802. https://www.jstor.org/stable/43826000

Moradi, S., Kähkönen, K., & Aaltonen, K. (2020). From Past to Present-the Development of Project Success Research. *Journal of Modern Project Management, 8*(1). https://doi.org/10.19255/JMPM02301

Morris, P. (1997). *The Management of Projects*. ICE Publishing. http://worldcat.org/isbn/0727725939

Morris, P. (2011). Managing the Front-End: Back to the beginning. *Project perspectives, 33*, 4-9. https://www.pmi.org/learning/library/managing-front-end-project-business-strategy-7500

Morris, P., & Hough, G. (1987). *The Anatomy of Major Projects: A Study of the Reality of Project Management*. John Wiley & Sons. https://inis.iaea.org/search/search.aspx?orig_q=RN:21028774

Morris, P. W. (2009). Implementing strategy through project management: The importance of managing the project front-end. In *Making essential choices with scant information* (pp. 39-67). Springer. https://doi.org/10.1057/9780230236837_3

Morris, P. W., & Geraldi, J. (2011). Managing the institutional context for projects. *Project management journal, 42*(6), 20-32. https://doi.org/10.1002/pmj.20271

Morris, P. W. G. (2013). *Reconstructing Project Management*. John Wiley & Sons. https://doi.org/10.1002/9781118536698

Morris, P. W. G., Hough, G. H., & Major Projects Association. (1986). *Preconditions of success and failure in major projects templeton college*. Oxford: Templeton College, the Oxford Centre for Management Studies. http://prism.librarymanagementcloud.co.uk/brighton-ac/items/246306

Müller, R., & Jugdev, K. (2012). Critical success factors in projects: Pinto, Slevin, and Prescott-the elucidation of project success. *International Journal of Managing Projects in Business, 5*(4), 757-775. https://doi.org/10.1108/17538371211269040

Nelson, R. R. (2008). Project retrospectives: Evaluating project success, failure, and everything in between. *MIS Quarterly Executive, 4*(3), 5. https://aisel.aisnet.org/misqe/vol4/iss3/5

NTSB. (2016a). *History of The National Transportation Safety Board*. Technical Report National Transportation Safety Board. https://www.ntsb.gov/Pages/home.aspx

NTSB. (2016b). *Mission Statement of The National Transportation Safety Board*. Technical Report National Transportation Safety Board. https://www.ntsb.gov/Pages/home.aspx

Packendorff, J. (1995). Inquiring into the temporary organization: new directions for project management research. *Scandinavian journal of management, 11*(4), 319-333. https://doi.org/10.1016/0956-5221(95)00018-Q

Pankratz, O., & Basten, D. (2013). Eliminating Failure by learning from it–Systematic review of IS project failure. *ICIS 2013 Proceedings*, 4. https://aisel.aisnet.org/icis2013/proceedings/ProjectManagement/4

Pinto, J. K., & Mantel, S. J. (1990). The causes of project failure. *IEEE transactions on engineering management, 37*(4), 269-276. https://doi.org/10.1109/17.62322

PMI. (2013). *A Guide to the Project Management Body of Knowledge* (5th ed.). Project Management Institute. https://www.pmi.org/pmbok-guide-standards/foundational/pmbok

PMI. (2017). *A Guide to the Project Management Body of Knowledge* (6th ed.). Project Management Institute. https://www.pmi.org/pmbok-guide-standards/foundational/pmbok

Rigsrevisionen. (2010). *Report to the State Auditors on the digital land registration project*. Technical Report Rigsrevisionen (National Auditor). https://rigsrevisionen.dk/revisionssager-arkiv/2010/aug/beretning-om-det-digitale-tinglysningsprojekt

Rigsrevisionen. (2011). *Report to the State Auditors on the Travel Card*. Technical Report Rigsrevisionen (National Auditor). https://rigsrevisionen.dk/Media/A/0/9-2010.pdf

Rigsrevisionen. (2013). *Report on the police IT system POLSAG*. Technical Report Rigsrevisionen (National Auditor). https://rigsrevisionen.dk/revisionssager-arkiv/2013/mar/beretning-om-politiets-it-system-polsag

Samset, K., & Volden, G. H. (2016). Front-end definition of projects: Ten paradoxes and some reflections regarding project management and project governance. *International journal of project management, 34*(2), 297-313. https://doi.org/10.1016/j.ijproman.2015.01.014

Sauer, C. (1993). *Why Information Systems Fail: A Case Study Approach*. Alfred Waller Ltd. https://dl.acm.org/doi/abs/10.5555/174553

Sauer, C. (1999). Deciding the future for IS failures: not the choice you might think. In W. Currie & B. Galliers (Eds.), *Rethinking management information systems* (pp. 279-309). Oxford University Press.

Sauser, B. J., Reilly, R. R., & Shenhar, A. J. (2009). Why projects fail? How contingency theory can provide new insights–A comparative analysis of NASA's Mars Climate Orbiter loss. *International journal of project management, 27*(7), 665-679. https://doi.org/10.1016/j.ijproman.2009.01.004

Schuck, P. H. (2015). *Why Government Fails So Often: And How It Can Do Better.* Princeton University Press. https://doi.org/10.1515/9781400850044

Serrador, P., & Pinto, J. K. (2015). Does Agile work?—A quantitative analysis of agile project success. *International journal of project management, 33*(5), 1040-1051. https://doi.org/10.1016/j.ijproman.2015.01.006

Serrador, P., & Turner, R. (2015). The relationship between project success and project efficiency. *Project management journal, 46*(1), 30-39. https://doi.org/10.1002/pmj.21468

Sharp, D. J., & Salter, S. B. (1997). Project escalation and sunk costs: A test of the international generalizability of agency and prospect theories. *Journal of International Business Studies, 28*(1), 101-121. https://doi.org/10.1057/palgrave.jibs.8490095

Shenhar, A. J., & Dvir, D. (2007). *Reinventing project management: the diamond approach to successful growth and innovation.* Harvard Business Review Press. https://cris.bgu.ac.il/en/publications/reinventing-project-management-the-diamond-approach-to-successful

Simon, H. A., Egidi, M., & Viale, R. (2008). *Economics, Bounded Rationality and the Cognitive Revolution*. Edward Elgar Publishing Ltd. https://www.e-elgar.com/shop/gbp/economics-bounded-rationality-and-the-cognitive-revolution-9781847208965.html

Smyth, H. J., & Morris, P. W. (2007). An epistemological evaluation of research into projects and their management: Methodological issues. *International journal of project management, 25*(4), 423-436. https://doi.org/10.1016/j.ijproman.2007.01.006

Sommerville, I. (2016). *Software Engineering* (10th ed.). Addison Wesley. https://mycourses.aalto.fi/pluginfile.php/1177979/mod_resource/content/1/Sommerville-Software-Engineering-10ed.pdf

Standing, C., Guilfoyle, A., Lin, C., & Love, P. E. (2006). The attribution of success and failure in IT projects. *Industrial Management & Data Systems, 106*(8), 1148-1165. https://doi.org/10.1108/02635570610710809

Standish. (1995). *Chaos*. Technical Report The Standish Group. https://www.csus.edu/indiv/r/rengstorffj/obe152-spring02/articles/standishchaos.pdf

Standish. (2013). *The Chaos Manifesto 2013*. Technical Report The Standish Group. https://www.immagic.com/eLibrary/ARCHIVES/GENERAL/GENREF/S130301C.pdf

Standish. (2014). *The Standish Group Report*. Technical Report The Standish Group. https://simpleisbetterthancomplex.com/media/2016/10/chaos-report.pdf

Staw, B. M. (1981). The escalation of commitment to a course of action. *Academy of management Review, 6*(4), 577-587. https://doi.org/10.5465/amr.1981.4285694

Sutton, R. I., & Staw, B. M. (1995). What theory is not. *Administrative science quarterly, 40*(3), 371-384. https://doi.org/10.2307/2393788

Tan, H.-T., & Yates, J. F. (1995). Sunk cost effects: The influences of instruction and future return estimates. *Organizational behavior and human decision processes, 63*(3), 311-319. https://doi.org/10.1006/obhd.1995.1082

Thomas, G., & Fernández, W. (2008). Success in IT projects: A matter of definition? *International journal of project management, 26*(7), 733-742. https://doi.org/10.1016/j.ijproman.2008.06.003

Turner, J. R. (1999). *The Handbook of Project-Based Management: Improving the Processes for Achieving Strategic Objectives* (2nd ed.). McGraw-Hill Publishing Co. http://msessd.ioe.edu.np/wp-content/uploads/2017/04/14-Programme-Management.pdf

Turner, J. R. (2014). *Handbook of Project-Based Management. Leading Strategic Change in Organizations* (4th ed.). McGraw-Hill Professional.

Turner, R., & Zolin, R. (2012). Forecasting success on large projects: developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames. *Project management journal, 43*(5), 87-99. https://doi.org/10.1002/pmj.21289

Weick, K. E. (1995). What theory is not, theorizing is. *Administrative science quarterly, 40*(3), 385-390. https://doi.org/10.2307/2393789

Westfall, J. E., Jasper, J. D., & Christman, S. (2012). Inaction inertia, the sunk cost effect, and handedness: Avoiding the losses of past decisions. *Brain and cognition, 80*(2), 192-200. https://doi.org/10.1016/j.bandc.2012.06.003

Williams, T., & Samset, K. (2010). Issues in front-end decision making on projects. *Project management journal, 41*(2), 38-49. https://doi.org/10.1002/pmj.20160

Williams, T., Samset, K., & Sunnevåg, K. (2009). *Making essential choices with scant information: front-end decision making in major projects*. Springer. https://doi.org/10.1057/9780230236837

Wilson, M., & Howcroft, D. (2002). Re-conceptualising failure: social shaping meets IS research. *European Journal of Information Systems, 11*(4), 236-250. https://doi.org/10.1057/palgrave.ejis.3000437

Wise, J. A., & Debons, A. (1987). *Information Systems: Failure Analysis*. Springer Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-83091-4

Wynn Jr, D., & Williams, C. K. (2012). Principles for conducting critical realist case study research in information systems. *MIS quarterly, 36*(3), 787-810. https://doi.org/10.2307/41703481

Yardley, D. (2002). *Successful IT project delivery: Learning the lessons of project failure*. Addison-Wesley.

Yeow, A. Y. K., & Chua, C. E. H. (2020). Multiparty sensemaking: A technology-vendor selection case study. *Information Systems Journal, 30*(2), 334-368. https://doi.org/10.1111/isj.12263

Yourdon, E. (2003). *Death March* (2nd ed.). Yourdon Press Series. https://dl.acm.org/doi/abs/10.5555/940374

Zeelenberg, M., & Van Dijk, E. (1997). A reverse sunk cost effect in risky decision making: Sometimes we have too much invested to gamble. *Journal of Economic Psychology, 18*(6), 677-691. https://doi.org/10.1016/S0167-4870(97)00029-9

Appendix: Notions of Project Failure

Year	Authors	Concept of Failure	IT
1975	Lucas	System failure: System not used or not appreciated by the organisation.	•
1983	Baker, Fisher and Murphy	Project failure: Schedule and cost overruns.	
1984	Fortune and Bignell	System failure is shortfall between performance and standards. Classification of failure types: Type 1) Objectives not met; type 2) Undesirable side effects; type 3) Designes failures (e.g. a fuse); type 4) Inappropriate objectives.	
1986	Gilbreath	Project failure: Failure to meet (reasonable) stakeholder expectations. Failure is "the sum" of planning failure and execution failure.	
1987	Lyytinen and Hirshheim	Project failure: Expectation failure (failure to meet expectations of stakeholders). The analysis also discusses: Correspondance failure (failure to meet specified requirements); process failure (failure to meet budget and resource constraints; and interaction failure (the system fails to be adopted by users).	•
1987	Morris and Hough	Measures of success and failure: 1) Project functionality (technical, financially or otherwise), 2) triple constraint, 3) Contractors' commercial performance, 4) In case of cancellation: well justified and efficiently done.	
1988	de Witt	The success of a project and project management may be determined by evaluating performance against success criteria or objectives.	
1993	Sauer	System failure: Failure to survive; as long as the system can attract funding the it must fulfil som organisational need, and therefore not be a failure.	•
1995	Cole	Runaway project: failed significantly to achieve its objectives and/or exceeded its original budget by at least 30%	•
1995	Standish Group	Project success: Completed on time, within budget to original specification; Project challenged: Completed and operational but delayed, over budget and reduced scope; Project Impaired: Cancelled during development cycle.	•
1995	Jones	Absolute failure: Termination before completion; relative failure: Exceeds anticipated costs and schedules by more than 50 per cent, or project delivered with quality delays full client utilization for more than six month after nominal delivery date.	•
1996	Flowers	Information system failure: The system is abandoned before completion, or the system does not perform as intended, or the system is rejected and underutilized by users, or cost of developments exceeds benefits provided by the system.	•
1998	Glass	Runaway project: Follows Cole 1999, but the cost or schedule failure threshold is 100% rather than Cole's 30%.	•
1998	Linberg	Project failure: The project is a failure, if it is not a learning experience for software developers. Other failure concepts, e.g. the triple constraint, are less important.	•
2001	Brown	Project failure classification criteria: non-delivery, late delivery, delivery over budget, failure to match the required specification or requiring significant changes. (According to Brown (2001), these are the criteria of the UK National Auditor's Office).	•
2002	Yardley	Types of IT project failure: Degradation of business capability or competitive advantage; increase in operating costs; failure to meet critical business requirements; low user satisfaction; loss of control (of requirements or planning).	•
2003	Ewusi-Mansah	Two categories of software failure: 1) failure to meet user expectations, 2) failure to produce a functioning system (development failure). Software development failure: One of the following: 1) failure to "achieve the functional objectives of the project", 2) failure to meet "the original cost or schedule estimates."	•
2002	Wilson and Howcroft	Project failure is constituted by non-achievement of standards agreed, for example requirements, budget, schedule, termination, cost not justified by benefits. Willson and Howcroft distinguish between project failure, system failure (not working properly) and user failure (the system is not used).	•
2003	Yourdon	Death march project: exceeds schedule, budget, staff resources by more than 50 per cent.	•
2005	Nelson	Distinguishes "Process-based measures of project success" (triple constraint) from "Outcome-based measures of success" (use, learning, and value). Combinations include: "Failed successes" (process success and outcome failure), and "Successful failures": (process failure and outcome success).	•
2005	APM	Project failure is contingent on stakeholder expectations, since "Project success is the satisfaction of stakeholder needs and is measured by the success criteria as identified and agreed at the start of the project." (APM, 2005). A later version of APM's Body of Knowledge excludes an explicit definition of project success.	
2006	IPMA	Project failure is contingent on stakeholder expectations, since project success is defined as "'the appreciation by the various interested parties of the project outcomes"'. This definition is more challenging than 'to produce the project deliverables within time and budget', which is only part of it." (IPMA, 2006).	
2006	Agarwal and Rathod	The important criteria: Cost, time, and scope (functionality and quality). To "software professionals" functionality within scope is most important, cost is considered least important.	•
2007	Cadle and Yeates	The project management textbook by Cadle and Yeates (2007) follows the definitions by Standish Group Group 1995 (see above).	•
2013	PMI	Project success: Complete within latest approved constraints of scope, time, cost, quality, resources and risk approved. Project failure: by inference measured relative to above constraints.	
2013	Kerzner	Project failure for project manager: Failure to meet triple constraint; for stakeholders: Cost exceed benefits or to late delivery, or failure to achieve targeted benefits or value, or project no longer satisfies needs.	•
2014a	Dalcher	Levels of project success: 1) Project management success (efficiency and performance), 2) Project success (Objectives, benefits, stakeholders), 3) Business success (Value creation and delivery), 4) Future potential (New markets, skills, opportunities).	•
2016	Hughes, Dwivedi, Simintiras and Rana	System failure is "complex and multifaceted", but "The key measure of failure is whether the system receives sufficient support for it to continue to exist (Sauer 1993); without this the project is a certain failure."	•
2017	PMI	Project success: Complete within latest approved constraints of scope, time, cost, quality, resources and risk approved. Project failure: by inference measured relative to above constraints. The same definition as (PMI, 2013).	
2020	Baghizadeh, Cecez-Kecmanovic, and Schlagwein.	Recommend "extending the research focus from ISD project failure as an end state towards ISD project distress and the problematic situations experienced during ISD projects. This shift in focus in IS failure research towards early treatment of ISD project distress is expected to produce valuable knowledge of high relevance to practice."	•