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Investment evaluation within project management: an information systems perspective

Z Irani*

Brunel Business School, Brunel University, Uxbridge, UK

This paper is seeking to make a contribution through exploring project management from the perspective of information systems (IS) investment evaluation. Organizational investments in IS are significant in financial terms and, as a result, management would appear set to increasingly scrutinize such expenditure through *tighter* forms of decision-making and corporate governance. In turn, this has increased the motivation of project managers to *appropriately* evaluate the impact of their IS *before*, *during* and *after* the investments are signed off. This perspective is not restricted to any one industry sector, with the author seeking motivation for a better understanding of investment evaluation within a project management context. This paper sets out to explain *why* and *how* investment evaluation should be embedded in project management in order to support an increase in the effectiveness of project management, thereby increasing the prospects of project *success*. While doing so, the reader will be provided with several touch-points that serve to outline the purpose and challenges facing those seeking to evaluate their investments. The author starts off with a contextualization of project management and its phased activities, such that a clear understanding of the contribution that investment evaluation plays within robust project management can be demonstrated. Then, the perspective of *investment versus consumption* is presented, grounded within the strategic grid, which classifies information technology-based projects as either: strategic, turnaround, factory or support. The author then presents evaluation as a life-cycle process, where evaluation is classified into four distinctive phases, namely *ex-ante evaluation*, *metrics*, *command and control* and *ex-post evaluation*, in doing so, emphasizing that evaluation needs to be seen as a process that runs through the life cycle of a project rather than as a hurdle that needs to be cleared to ensure financial approval.

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Introduction

Little has changed in recent times with regards to the adoption of Information Technology (IT) and Information Systems (IS), with most large public and private sector investments remaining lengthy, time consuming and complex processes. Therefore, unsurprisingly, issues associated with its management and perceived delivery of *success* should appear to be of paramount importance to senior management. Yet, many companies approach the whole management of technology in an unstructured or ad hoc manner throughout the systems' life cycle, whether from the investment appraisal stage (Kaplan, 1986; Irani and Love, 2001) or at the post-implementation evaluation phase (Kumar, 1990; Al-Yaseen *et al*, 2006). A clearer understanding of the role that investment evaluation plays within robust project management needs to take place, thereby allowing decision-makers and project managers to navigate towards joint success rather than seeing these management activities as isolated and independent business processes.

Investment evaluation needs to be viewed as a parallel management activity to project management, where investment decisions are closely mapped to the *costs*, *benefits* and *risks* that are used to underpin the decision of whether to invest or not. In addition, this management activity should be seen as providing a business or organizational function with an opportunity to craft itself as a learning organization (Jashapara, 2003) after having embraced change through a structured change management process (Voropajev, 1997). In doing so, it is supportive of building tacit knowledge that facilitates organizational memory building, which in turn, feeds into the management and *success* of future projects (Irani and Love, 2001). Programme management needs to be increasingly recognized as a means to bridge the gap between organizational strategy and project delivery, with the evaluation process (*ex-ante* and *ex-post*) acting as a balance and check process. In further support, Operational Research (OR) has given essential scientific contributions to the use of project management, not just through the use of mathematical models to understand and to represent projects as interconnected

*Correspondence: Z Irani, Brunel Business School, Brunel University, Kingston Lane, Uxbridge, UB8 3PH, UK.

activities, but also by the development of algorithms and aids to support the decision-making role that project managers need to adopt.

This paper is seeking to make a contribution to the normative literature through exploring project management from the perspective of information systems investment evaluation. The author starts with a contextualization of project management and its phases, such that a clear understanding of the contribution that investment evaluation plays within robust project management can be demonstrated. Then, the issue of investment *versus* consumption is presented, grounded within the strategic grid, which classifies IT-based projects as either: strategic, turnaround, factory or support. A description of the tools available to those with the responsibility of making such investment-related decisions is presented, together with their shortfalls, such that the challenges surrounding investment decision-making can be better understood.

Project evaluation: revisiting the norms

The importance of investing in new IS architectures and infrastructures has become a topical issue within organizations, which is motivated by the need to deliver better value products and services, through robust and responsive supply chains. With this in mind, business managers are seeking to use *appropriate* techniques and methodologies to appraise and justify the financial contribution of IS at strategic, operational and tactical levels. Such a typology is drawn from the seminal work of Anthony (1965), where organizational management is classified into strategic, tactical and operational, with Irani and Love (2001) mapping such levels to corresponding benefit classifications. Managers, however, continue to express concern regarding their ability to appraise IS investments prior to committing financial resources and emotional energy (Raymond *et al*, 1995; Lefley and Sarkis, 1997; Irani and Love, 2001; Irani *et al*, 2001, 2005, 2008; Irani, 2002; Ghoneim and El-Haddadeh, 2006). The problems associated with the evaluation of IS are ubiquitous, and as a result, a wealth of research and discussion has taken place.

The design and development of IS can be a lengthy process, take considerable time, involve multiple stakeholders and be costly to implement. Understanding the needs of the user is notoriously difficult, especially when capturing the feelings and emotions of a non-physical system. However, advancements in web-based IT systems have brought about a change in the way IS are developed and evaluated, with approaches such as psychometrics being discussed by Fung *et al* (2000). Similarly, studies by Stewart and Mohamed (2004) encourage managers to closely monitor indicators from the user orientation and technology/system perspectives, and explain that a slack in these indicators often signals retarding performance in the operational, strategic competitiveness and benefits perspectives of the web-based projects. What is widely accepted though, regardless of underpinning technology, is that IS need to be maintained and constantly re-aligned to business processes, which requires capital expenditures and much management (Kaplan and Norton, 1996; Burn and Szeto, 2000). As a result, issues associated with their evaluation would presumably assume great importance and attention. However, this is often not the case.

The challenges that surround the justification of investments in technology are not new. IS have always involved lots of people, taken too long to develop, cost too much to implement and maintain and are frequently not perceived to be delivering the benefits that underpin the motivation to invest (Brynjolfsson, 1993; Lefley and Sarkis, 1997; Ballantine and Stray, 1998; Irani and Love, 2001, 2002). As a consequence of the inherent problems consistently identified with IS evaluation, it would appear that there is a 'crisis of understanding' confronting the private and public sectors, regarding its *importance*, *role* and *relevance* throughout a project's life cycle.

A lack of understanding as to *why*, *how* and *when* to evaluate appears to be the central issue facing managers, with little consensus around what constitutes meaningful evaluation. This formed the doctrine of the work presented by Irani and Love (2002) in their presentation of taxonomies of IS evaluation [techniques and methodologies]. Fundamentally, it appears that managers need to have a better understanding about the impact of IS on organizational performance and an understanding of the benefits, costs and risks associated with financial and social capital investments. Neglecting to address, or at least consider, such factors will result in a verbose business case being developed.

Much intellectual effort has been devoted to creating structured methods to aid the *development* of IS – in a rather technology-centric sense and, notwithstanding the significant gains in approaches to project management. The same, however, does not seem to hold true for the *evaluation* of investments in such systems (in a business-centric sense), or a value-added sense when considering public sector e-Government investments. The use of methodological approaches to project development has undoubtedly contributed to the creation of more flexible IS, whether web-based or infrastructure but, the majority of decisions for IS introduction would, according to Farbey *et al* (1993), Irani and Love (2001), and Irani *et al* (2008), seem to be taking place without a detailed *priori* appraisal of the motivation and impact (positive and negative) of such an investment and, the expected costs, benefits and risks to the organization. Worryingly, Remenyi (1999) explains that many organizations are not clear as to what constitutes a sound business case and how to go about producing one.

In recent years, the changing role of IS has given new impetus to the problem of investment evaluation; from operational deployments in the manufacturing and public sector environments, see for example Irani *et al*, 2001 and Hackney *et al*, 2007, respectively, through to strategic deployments in the public and financial sectors (Scarbrough, 2003; Irani *et al*, 2005). The complexity of such systems combined with the uncertainty and unpredictability associated with the scale

Table 1 Selection of OR techniques to appraise investments.

OR classification	*Method*	*References*
Analytic (Portfolio) appraisal	Weighted scoring models	Saaty (1980)
	Value analysis	Meredith and Suresh (1986)
	Risk analysis	Roth *et al* (1991)
	Fuzzy cognitive mapping	Irani *et al* (2002)
Integrated appraisal	Multi-attribute/Multi-criteria	Bozda *et al* (2003)
	Pricing models	Miller and Arikan (2004)
Soft systems	Soft systems	Checkland (1985)
	Total systems intervention	Flood and Jackson (1991)

and timing of resulting goals, have always pointed to the need for improved management of IS projects. Such an understanding of the need to embed investment evaluation within the project management process can help an organization better utilize resources and improve its position *vis-à-vis* its competitors, thus supporting differentiation.

The consequence of the evolving nature of IS deployments are that they change from being operational and process driven, to ones that are increasingly strategically focused over the long term. This means that the scope and impact of benefits generated and costs incurred, many of which may be indirect and intangible (or at least non-financial), makes such costs and benefits unsuitable for inclusion within traditional appraisal techniques and methodologies. The implications are that communities in both the public and private sectors are reappraising the effectiveness of their appraisal techniques and the contribution that appraisal as a management process plays within broader project management. This is ever more driven by the need to ensure the appropriate allocation of financial resources, given financial prudence in the current economic climate. However, care must be taken not to ignore the more scientific and mathematically grounded approaches to appraisal, such as those underpinned by OR, as identified by Renkema and Berghout (1997) as part of a broader list. Traditionally, the evaluation of projects has been done using financial appraisal techniques that adopt standard indexes such as Net Present Value, Rate of Return, etc. Unfortunately, such approaches tend to give little importance to long-term effects and do not consider other important non-financial criteria. Table 1 seeks to offer a selection of OR-grounded methods and their respective classification when considered as approaches to investment appraisal. What is clear, is that the introduction of Multi-Criteria Decision approaches by OR brought about a change in the way investments are seen and dealt with by decision-makers, and thus brought about enriching a somewhat myopic area of management.

The increased motivation to evaluate IS, before, during and after [the project] has brought to the fore the complexity of accommodating human and organizational factors. Specifically, quantifying the benefits and costs within traditional accounting approaches to appraisal within the broader evaluation process. In response, new and innovative approaches have emerged, with Irani and Love (2002) offering a taxonomy of techniques, all of which claim to address, in part or whole, the complexity of investment appraisal. However, a lack of 'take-up' of such emergent techniques due to their possible complexity, and the increased need to consider benefits, costs and risk as a portfolio of inter-related considerations, have all been reported as barriers to such adoption, as empirically presented by Ballantine and Stray (1998, 1999) and more recently, Love *et al* (2005).

IS evaluation as a management process, both before and after its deployment, is important, not least because of the large amounts of capital consumed, and thus, the opportunity of using such funds elsewhere within the organization. As a result, there is a clear desire by managers to better understand the implications of capital spending through robust evaluation processes; before committing time and money to a project. Indeed, many large public sector investments, in the defence and health sectors especially, partition a fixed percentage of the projects' budget for an investment evaluation exercise.

However, there is often such political momentum that to *not* produce the 'right' outcome [to initiate the project pass or, conclude project success] could be personally damaging, as often, the project champion will have invested much personal and professional energy in the project. Any investment decision is often carefully crafted, thus emphasizing that investment evaluation is a highly political process (Kaplan and Duchon, 1988). Hence, organizations need to be reflective in terms of re-visiting past *successes* and *failures* before initiating new projects, thereby improving their levels of success. Therefore, before any project is initiated, the author proposes that there are key issues that need to be reviewed, which include:

- Ensure that the project manager is suitably qualified and experienced (established credibility) in all aspects of project management and project management methodologies, and where there is a lack of knowledge, that suitable

'buy-in' experiences can be sourced and utilized. See, Kerzner (2006).
- Set clear expectations that link the project outcomes (goals), but recognize that these might change during the project's life cycle. While some project managers expect the best, they should also plan for the worst. This could be considered rather pessimistic, but it does mitigate risk. See, Raz and Michael (2001).
- Prepare for change through the project management of organizational change. See, Partington (1996).
- Ensure that there are strong levels of leadership at all levels of the project, with open and direct levels of communication. See, Zimmerer and Yasin (1998).
- Ensure that the project plan is detailed and robust, and where needed, regularly updated.
- Consider human and organizational factors, in particular, geographical and ethical considerations that might impact the pace of the project when set against project milestones. See, Loo (2002)
- Embed methodologies and standards such as Prompt[1], Prince[2] and Prince 2[3] within the planned approach to project management. See, Dai and Wells (2004).
- Ensure a clear division, yet description of requirements from the project manager(s) and the project sponsor(s). See, Norrie and Walker (2004).

While there is never any guarantee of project success, the above can go some way towards realizing the achievement of project goals.

Scope and impact of IS investment

The scope and ever expanding impact of IS means that they can be developed and deployed within an organization for a variety of purposes. Indeed, the same type of IS can be used in different environments to significantly different ends. Such deployments are largely shaped by the people within the organization and often influenced by the strategic intent motivating the scope with which the technology is used. McFarlan (1984), and updated more recently by Nolan and McFarlan (2005), proposed and respectively revised, the *strategic grid* that linked the different kinds of IS deployments with business strategies. This is presented by way of a two-by-two matrix, where each quadrant represents a possible role of technology within the organization; *support*, *factory*, *turnaround* and *strategic*. It may not be unusual to see technology move between quadrants over time, as both the technology and the organization mature. Figure 1 proposes the application portfolio as an evolving deployment of technology over time, and similarly characterizes it [the information system] against the resulting complexity of project management. Mapped against each application is the complexity level from a project management perspective; given the diverse range of stakeholders involved, size of the deployment in physical terms, capital cost involved, strategic implications and associated human and organizational consequences. In Figure 1, it can be seen that project management complexity changes from high to low, as the type of IS deployment moves over time from strategic/turnaround to factory/support. Notwithstanding this change in complexity, the associated evaluation should still be embedded within the project management process.

There remains a real need for managers to understand the implications of the strategic grid in terms of how to manage these different types of IS as the organization matures and indeed, technology develops. Specifically, the organization will start to harness and retain both tacit and explicit knowledge which might well be supportive in the movement from one grid to another over time. In turn, this will have a direct link with project management and the resulting challenges.

The increasing diversity of IS applications has led to a range of different project types, each displaying their own characteristics and justified on the grounds of differing impacts across organizational functions, from strategic through to the daily use of IS for an operational role. The consequence here is that the author proffers that there cannot be any single approach to investment appraisal that can be used across *all* types of technologies, as both the technology and the implications of applying the technology are far reaching, especially when considered in the context of Figure 1. Also, the internal knowledge available to understand and exploit such technology will mature over time.

Butler Cox (1990) identifies three types of IS investment types that map to projects that display quite different characteristics and thus, significantly differ from one another's portfolios of costs, benefit and risks. This taxonomy approach complements the original thinking of McFarlan (1984), with the investment types summarized (*ibid.*) as:

- *No Choice Option*—In this instance, there is no need to create a business case, as often the decision to proceed is based on a statutory regulation, for example, Government regulation in the pharmaceutical industry or instruction for corporate compliance. These are investments that the organization is compelled or forced to undertake. A mandatory investment in an IS may also be caused by some new legal requirement or legislation of conformity to traceability, for example, conformance to the Sarbanes–Oxley Act as discussed by Braganza and Hackney (2007) within an IS change context. In mapping this investment type onto the

[1] *PROMPT* was a project management method created by Simpact Systems Ltd in 1975 and adopted by the Central Computer and Telecommunications Agency (CCTA) in 1979, since renamed the Office of Government Commerce (COGC), as the standard to be used for *all* Government IS projects.

[2] *PRINCE* superseded PROMPT in 1989 when it was launched, and later became widely used on Government projects. PRINCE remains in the public domain and copyright is retained by the Crown. PRINCE is a registered trademark of OGC.

[3] *PRINCE2* emerged in 1996, having been contributed to by a consortium of some 150 European organizations. It is now an industry standard.

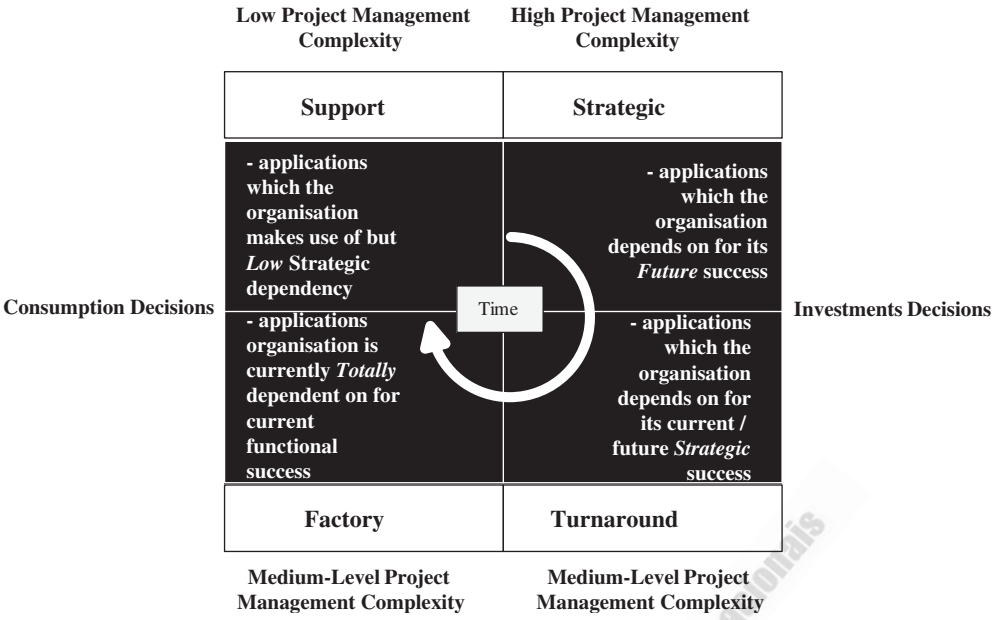

Figure 1 Evolving deployment of information systems.
Source: (Adapted from McFarlan, 1984–strategic grid).

McFarlan (1984) grid, it would appear in the bottom-left quadrant.

- *Infrastructure investments*— These are investments in technological platforms, communication systems, networks, etc., to enable some future systems or services. A typical example here would be the purchase of the 3G network on the basis of future telecommunications revenue. Infrastructure investments present problems to evaluate because of the intrinsic returns on the infrastructure, which simply enable other projects. However, without such infrastructures, future revenues are not realizable. Such investments are often significant financial commitments that run over many years but which might be underpinned by Government incentives. In mapping this investment type onto the McFarlan (1984) grid, it would appear in the top-left quadrant.
- *Research investments*—These are investments concerned with developing and learning about the next generation of technologies (or systems) and establishing their potential. They are often not commercially viable in the 'concept state' but could be after the principle has been established and commercially scaled, and as such present evaluation problems, as the objectives of such investments are unclear and often visionary. They are usually long term and difficult to quantify financially but could potentially be very lucrative. In mapping this investment type onto the McFarlan (1984) grid, it would appear in the top-right quadrant.

Project management: aligning project management with evaluation

The measurement of a projects' success or failure, regardless of its complexity of scale or size of financial investment, must be measured against well-defined objectives and criteria to allow an objective assessment of progress. The fundamentals behind this are explained by Lycett *et al* (2004), where project performance measures ensure robust governance and goal motivation. However, at a conceptual level, such performance evaluation within a project management environment questions whether one should:

- Consider a polarity between success and failure, thereby questioning whether success really exists or, whether everything else is just a degree of failure.
    - Exploring the granularity in this spectrum
    - Enabling the movement through tools and management techniques
- Establish whether a clear focus for the project can be built around the quantifiable alone;
- Maintain a sense of 'heads-up', thus providing an opportunity for corrective action to be taken.

Established criteria and performance measures by decision-makers before the project is ever initiated need to be rolled into the management of the project, thus forming a life-cycle evaluation approach. There are also more practical organizational implications, with Hobday (2000) offering strategies to stimulate organizational learning and technical leadership, which includes the deployment of coordinators along functional lines to cut across project interests and incentives, thereby contributing towards an environment where benchmarking can take place, with Philips (2003) arguing a clear contribution between benchmarking of performance measures and a firm becoming a learning organization.

Figure 2 Polarity of a project.

Milosevica and Patanakulb (2005) classify such measures as being either internal or external, with project cost, time and quality being classified as internal measures of project efficiency, while external measures are those that benefit the firm as a whole, and include market share, share value and customer satisfaction. In adopting this position, it can be argued that external measures support improvements in effectiveness but require clear strategies for achievement, but internal measures are more associated with efficiency and based around plans rather than strategies. Figure 2 presents the polarity of projects and shows how a project fits within a continuum.

These need to be used to determine whether key performance milestones are being met and to keep the project on track, and to establish how well the project is being managed against set and agreed targets. They are also needed in order to consider whether the specified project outputs have been delivered, with the outcomes realized to the satisfaction of the stakeholders.

However, a challenge that project managers face, is the alignment of these project management criteria with those used by the decision-makers during the ex-ante evaluation of the investment and then, at the ex-post evaluation stage. This view propagates the thesis of *life-cycle evaluation as a robust view of project management, which considers the quantitative and qualitative perspectives of a project through the eyes of its stakeholders*.

Project performance evaluation: before, during and after

Organizational investments in IS are significant in terms of financial and emotional resource, and as a result, management would appear set to increasingly scrutinize such expenditure through *tighter* project performance evaluation. This, in turn, leads to an increased motivation to appropriately evaluate the impact of IS *before*, *during* and *after* the investment is signed off. This can be achieved through new or improved ways of project performance evaluation while recognizing that there are a combination of techniques and methodologies to support the nature of the investment. There remains an extensive list of attributes used in the IS evaluation process, with Gemmell and Pagano (2003) and more recently Osawuwa and Chiemeke (2008) presenting an exhaustive list. In support of what is essentially life-cycle evaluation, Figure 3 presents project management as a phased 'gated' process, drawing on key principals of project management, yet, not detaching it [project management] from a projects' implementation life cycle. This is then set against a backdrop of organizational learning.

Phase 1—ex-ante evaluation

The adoption of IS and the development of the resulting infrastructures are being increasingly viewed on the basis of consumption, and as a necessary resource for even the most fundamental business to exist. This therefore questions whether it is appropriate to consider IS' spending as an investment, and thus exploring what drives spending on IS; whether seen as an investment or as a matter of consumption. Doms (2004) reported the results of research undertaken by the Federal Reserve Bank in the USA, which concludes that technological changes over the last decade have been the driving forces behind the high rates of investment in new technology. Therefore, in considering *what* investment levels organizations might make in the future and *how* such decisions will be taken, it is important to consider the level and kind of technological changes that might lie ahead. In turn, this has a bearing on the magnitude and cost of resulting investments, which will have scalable project management challenges. This will have significant implications on the management of the project from the perspective of *attitude to risk*, *cash-flow of the organization*, *timing of benefits* and *outflow of costs*.

To better understand the implications of the investment, organizations might consider mapping the kind of ex-ante appraisal techniques and methodologies available to the various quadrants in Figure 1, for example by considering more strategic appraisal techniques as being appropriate to the top-right quadrant through to traditional financial appraisal techniques for the top-left quadrant.

Such thinking will be supportive of longer-term strategic business planning and will be grounded against how the organization views the possible impact of the technology on the business. This leads to the thinking that adoption in the strategic and turnaround quadrant is akin to an investment, whereas adoption in the support or factory quadrant can be argued as consumption.

Table 2 is intended to start the debate about the link between investment nature and where it sits in respect to the application portfolio, and the techniques and methodologies available to provide a meaningful evaluation. Such natures, as

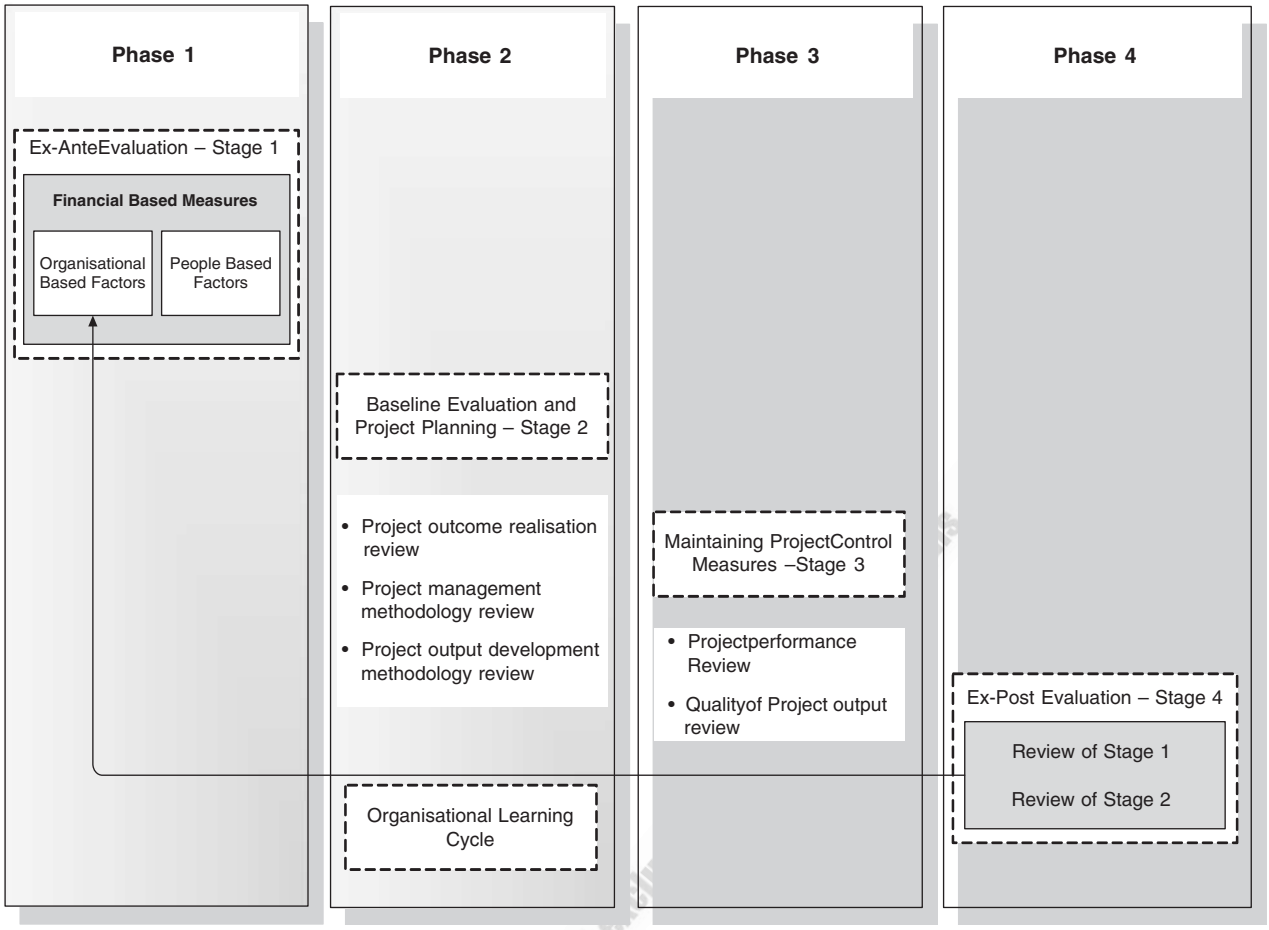

Figure 3 Phases of life-cycle evaluation.

Table 2 Ex-ante evaluation classification—Phase 1

Position in application portfolio (Investment nature)	*Ex-ante evaluation perspective*	*Investment vs consumption*	*Evaluation techniques*	*Reference*
Strategic (top right)	Strategic decision-making	Investment	Technical importance	Meredith and Suresh (1986)
		Investment	Competitive advantage	Naik and Chakravarty (1992)
		Investment	Critical success factors	Rockart (1979)
Support (top left)	Financial decision-making	Consumption	Payback	Hares and Royle (1994)
		Consumption	Return on capital	Lumby (1993)
		Consumption	Cost-benefit analysis	Pavone (1983)
• Operational to tactical (bottom left)	Integrated decision-making	Integrated	Scenario planning	Schoemaker (1995)
• Tactical to strategic (bottom right)		Integrated	Balanced scorecard	Kaplan and Norton (1992)
		Integrated	Multi-criteria	Irani *et al* (2002)

defined in Figure 1, are then mapped against a classification of *ex-ante* evaluation perspectives. An alignment on whether the perspective can be seen as an investment and consumption decision is then taken, with corresponding examples of evaluation techniques and methodologies with references.

Phase 2—metrics that feed in to ex-ante evaluation and project management process

Once the decision to spend organizational funds has been given, the outcome will have been based on much

documentation that will detail financial and organizational metrics, and be presented by the project champion. However, there might be a mismatch between those criteria used to take the decision, and those criteria used to evaluate the project. Also, the scope and sensitivity of the metrics will very much depend on the ex-ante evaluation perspective taken by the organization; to what extent metrics that are not financially underpinned are considered significant. Luu *et al* (2008) present those key performance indicators with evaluation approaches used within the construction sector, Jones and Hughes (2001) detail those from the private sector, while Irani and Love (2001) explain those used in the manufacturing sector. To some degree the metrics used to monitor the project will become reflective measures that allow a retrospective analysis of how the project was managed, and to what degree the planned changes proposed have been realized while recognizing that the time-line between project inception through to completion might well take several years, especially when it comes to a strategic or turnaround project. Also, many of the measures will have been best-guessed, especially when it comes to benefit realization and cost implication, which will have featured within the ex-ante evaluation process. The view taken by the organization, if embraced in a positive sense, regardless of success or failure, provides a unique opportunity for organizational learning to take place.

On a more practical level within the project plan, the scope of baseline metrics, set within a flexible project management environment needs to consider specific metrics. Table 3 goes sameway towards presenting those measures that feature within the *ex-ante* process and which will be monitored during the project, in a reflective sense, in order to monitor progress by the project management team.

The key to establishing appropriate baseline metrics within a project planning exercise is to ensure that the metric itself is useful and appropriate. Clearly, it needs to be measurable and set within the context of what is planned to be realized or towards a deliverable or milestone presented within the project plan. There needs to be relevance of the metric to the project [in part or as a whole] and thus, it is not possible to provide prescriptive baseline metrics as the context is always different, depending on the purpose, scope and where the project fits within Figure 1.

Impartiality is also important, specifically in regards to the person doing the measurement of the metric. Being impartial to internal politics is critical in ensuring that organizational learning and development can take place, thus being supportive of a learning culture where new ideas and change can flourish in such a way that future projects can benefit from the mistakes of the past.

Phase 3—project management as a command and control mechanism

Besner and Hobbs (2008) present a list of 70 project management tools, however these were not classified, but rather presented in an alphabetical order. The research does present the results of a survey, which identifies the tools in a decreasing order of average usage. Underpinning the use of tools, such as those identified, is a project plan. This plan acts as a detailed repository to support project delivery against the objectives used to justify the investment or organizational spend. This phase of the life cycle is where checks and balances are made to assess the degree with which progress is matched against the project plan. It also allows for benchmarking to take place, see for example Ramabadron *et al* (1997). To mechanize this process, there is a fundamental need to develop a Performance Management System (PMS), which goes beyond what Lohman *et al* (2004) describe as traditional PMSs that are based on costings and driven by operations. There is a need for a more balanced set of financial and non-financial measures, thus creating a type of management information system that is needed for controlling operations and projects. This view is not incompatible with the spread of measures found within Table 3, but recognizes that there might be a divergence between the measures used to justify the investment and those to measure its on-going performance. At an operational level, a PMS is where key metrics are constantly checked against required yield or return. Ying *et al* (2009) created a classification of factors that may affect project performance, which can then be used as metrics where project management practice is constructed. Indeed, Davidson *et al* (1999) and Hartman and Ashrafi (2002) identify project management metrics as factors affecting the *success* of projects. There is, however, a necessary balance required between excessive control and sufficient flexibility within the context of an evolving business strategy. There are several touch points that will be focused on by the project review team, which include:

- *Reality Check*—Planned *versus* actual project management methodologies. Projects change and evolve as internal and external factors 'kick-in'. The purpose here is to compare the actual approach against those detailed in the case for support and to reflect on such changes; see for example Besner and Hobbs (2008) for methodologies.
- *Benefit Realization*—The timing and scale of benefits being produced through the project. Comparison of planned outcome benefit-taxonomy with actual project outcomes; see for example Bradley (2006) for benefit realization in project management.
- *Time Management*—Mapping of key project stages against original timelines; project time management is a subset of project management. If slippage occurs then remedial action plans will need to be developed to ensure the project is put back on-track and that objectives are set to be realized; see for example O'Connell (2007) for time management in project management.
- *Cost Creep*—Ensure tight control is kept on direct project costs but even tighter control on indirect project costs,

Table 3 Metrics in project management—Phase 2

Position in application portfolio (Investment nature)	*Ex-ante evaluation perspective*	*Evaluation techniques*	*Measures/metrics*
Strategic (top right)	Strategic decision-making	Technical importance	• Link with strategic plan • Potential for innovation • Critical need for the business
		Competitive Advantage	• Link with the strategic plan • Sufficient cash-flows • Scale and timing of benefits • Scale and timing of costs • Risk mitigation and management
		Critical success factors (CSFs)	• Identify objectives central to business • What CSFs are central to meeting these objectives? • What decisions influence these CSFs? • What variables underpin these decisions? • How are these decisions measured? • What information flows support these decision points?
Support (top left)	Financial decision-making	Payback	• Duration of time before recovery of investment • Identify acceptable payback period • Consideration of cash flows rather than accounting profits • Consideration of timing [of] cash flows
		Return/Cost on capital	• Cost of debt • After tax cost of debt • Weighted average cost of debt • Cost of preferred stock
		Cost-benefit analysis	• Direct quantifiable costs • Indirect quantifiable costs • Indirect non-quantifiable costs
Operational to tactical (bottom left)	Integrated decision-making	Scenario planning	• Identify values, trends and trade-offs
Tactical to strategic (bottom right)			• Identify driving forces and indicators • Identify uncertainty • Determine pattern of interaction
		Balanced scorecard	• Financial measures • Non-financial measures • Long-term measures • Short-term measures • Performance drivers (Lead indicators) • Outcome measures (Lag indicators)
		Multi-criteria	• Hard measures • Soft measures • Weighted measures—hard and soft

which can be human or organizational; see for example Irani *et al* (1997).
- *Harmonization*—It will be necessary to keep aligned project benefits, costs and risks regardless of actual field conditions, and emergent new management practices. Recognizing that large projects have long benefit and cost gestation that will need constant re-alignment to ensure benefit realization and mitigation against cost-creep; see for example Box and Platt (2005).

As with all of the phases as detailed in Figure 2, it comes down to several key committees/decision-making bodies to conduct a review of each phase. Notwithstanding independence and a detachment of politics, individuals are often left juggling the two forces until the end of the project. Hence, committee structures are often the way forward, with the project manager(s) and the project champion often playing a leading role. However, it might well be appropriate to involve external consultants with either specific knowledge of the projects [or aspects] or expertise, or, simply to allow an external to offer a new perspective.

Phase 4—ex-post evaluation

Gulliver (1987) coined the notion of post-project appraisal with an influential learning element as its motivation. This management process is conducted by a team regarded as independent, with no prejudiced opinions, and with no interest in being an influencing factor on the results of the evaluation. The team has a higher degree of objectivity and scalability, such that any findings are made publically available, with the goal that such evaluations support worldwide learning from errors and the repetition of successes.

This phase of life-cycle evaluation acts as a post-implementation review stage to reflect on the level of *success* achieved, when compared with the rationale used to give the project the original go-ahead. The literature surrounding post-implementation evaluation is relatively sparse, with the normative works coming from Kumar (1990), Beynon-Davies *et al* (2004) and Al-Yaseen *et al* (2006, 2008). What these sources are in agreement about, is that post-implementation evaluation is a critical stage in the life-cycle evaluation process. Much of the reason for this lack of take-up appears to be underpinned by a sense that the monies have been spent on the project, and hence, there is little that can be done to correct past mistakes. Bajaj *et al* (2008) explain that even when 'sound' ex-ante evaluation has taken place, management often neglects to determine [as part of a post-implementation review] and communicate how well the investment aligned with the business strategy. Indeed, Cerullo (1980) presents a prescriptive list of questions for those involved in conducting such a post-investment. However, what organizations often fail to do with this approach, is to use the post-implementation evaluation phase as a step with which organizational learning can occur (in a constructive sense) thus, missing an opportunity to allow the good to be factored into future projects, yet have the bad engineered out. The substantive purpose of this phase is to determine whether:

- Project objectives have been achieved or that supporting rationale is provided where these have fallen short thus allowing for re-alignment.
- Target outcomes have been achieved or that supporting rationale is provided where these have fallen short thus allowing for re-alignment.
- To review performance against set measures.
- Cost, benefit and risk review, with an alignment of expected against realized.
- Stakeholder review to undertake client feedback, thus establishing performance against fit-for-purpose criteria.

Al-Yaseen *et al* (2008) explain the results of empirical research, which concluded that post-implementation evaluation was considered to be of more use as a management process to those organizations that were acquiring new systems. Of the companies surveyed, little over a third from a sample of 123 FTSE 500 companies carried out any form of post-implementation evaluation, mainly as a signing off exercise. The survey went on to conclude that practitioners do not appreciate the full range of benefits of a rigorous post-implementation evaluation process, which enforces a lack of appreciation, that negatively feeds-back into perceptions, and so forth, thereby becoming a self-fulfilling prophecy. In the two decades since the first major study reported by Kumar (1990), little appears to have changed. To further complicate the matter, there are problems with knowledge and experience retention, as those often involved in the project management, leave just before any post-implementation review starts, although Rogger and Heck (2004) go some way to providing conceptualized solutions.

Conclusions

IS projects are renowned for their high failure rates, although, the author is mindful that defining *success* and *failure* is nebulous. Although definitions vary within the literature, the common thread seems to be that a project fails if, in some way, it does not meet the expectations of its users or sponsors. These expectations are then converted into hard, measurable targets, like for example implementation costs, delivery deadlines or functional requirements that can almost always be evaluated through robust project management. The author of this paper has therefore sought to twine a strong link between ex-ante and ex-post evaluation through robust project management, and in doing so, emphasizes the importance of these factors, thus creating an environment where the original objectives of the investment can be better *managed* and *controlled*. This has been achieved by emphasizing that evaluation, as a process, is best used when grounded against a backdrop of project management, which led to the proposition of a four-step phased life-cycle approach.

This paper has sought to contextualize IS investments against a backdrop of the strategic grid, where techniques such as those offered by the OR community can be used to appraise such investments. This in turn prompts organizations to consider where within the strategic grid they decide to adopt technology thus raising the suggestion that adoption in the strategic and turnaround quadrant is akin to an investment, whereas adoption in the support or factory quadrant can be argued as consumption. The consequence of this is that investment decision-makers and subsequent project managers will need to make use of differing approaches to evaluation to better understand and accommodate the resulting implications.

The purpose of evaluation as a management activity is to predict (*ex-ante*) or assess (*ex-post*) *how* well an IS project meets the expectations of stakeholders. To view evaluation in simple cash or cost-benefit terms, only addresses a particular perspective. As this paper has shown, if *ex-ante* evaluation is used in isolation towards a broader management of the project, it simply offers myopia. Although a cash return on the investment is necessary, for a business operation to remain healthy or for public value to be achieved, a positive result cannot be taken as an indication that the project will succeed (or is succeeding) in meeting its stakeholders' expectations, or that the project has been adequately managed and as such is *successful*. The purpose of this paper has been to provide the reader with several touch-points through proposing a four-step phased life-cycle approach that serves to outline the purpose and challenges facing those seeking to evaluate their investments, within a contextualized project management environment, and in doing so, emphasizing that evaluation, as a process, is best when grounded against a backdrop of project management.

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