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Abstract

What can go wrong will go wrong! The rule of 'Murphy' can strike any unsuspecting project team and is best not forgotten. This is especially so if we consider the current UK construction industry agenda for performance improvement through a culture of eliminating waste (time, money, labour, materials) and a desire for 'zero defects.' This paper demonstrates (using 11 case study construction projects) that Murphy is alive and well on many projects and may indeed be visiting a site near you today. Design and construction professionals were interviewed on each project and information gathered resulted in the formation of a typology for each project. The typology indicated both project enhancing and detrimental events, which had taken place on each project. The typology allowed for the creation of 11 individual project 'footprints.' The footprints are compared and contrasted in this paper and reference is made to the procurement route (traditional, D&B and management) used on each project. The concepts of project risk, uncertainty, procurement systems and project success are also discussed.

Introduction

Murphy's law states that "what can go wrong, will go wrong". The law's namesake, Capt. Ed Murphy, was a development engineer who worked for the Wright Field Aircraft Lab. Frustrated by a transducer that was malfunctioning because of an error in wiring, Murphy remarked: "If there is any way to do it wrong, he will". Murphy was referring to the anonymous technician who had wired the equipment. George Nicholas, who was Northrop Aircraft's project manager on the job, immediately labelled Murphy's offhand remark "Murphy's Law" (Marino, 1999). The specific call for improvement in the UK construction process, and thereby reduce the likelihood and impact of Murphy, has, in recent years come from both the 'Latham' (1994) report *'Constructing the Team'* and the Egan's (1998) *'Rethinking Construction'*. Latham challenged the industry to increase productivity by reducing costs by 30%, use more partnering arrangements between clients & contractors and adopt less adversarial dispute resolution methods. The 1998 'Egan' report can be said to have acted as a catalyst for change within the construction industry. Anecdotal evidence seems to suggest that many of Latham's proposals for improvement are only now being met as a result of the Egan's initiatives being enacted. Egan challenged the industry to reduce time and cost by 10% annually, defects by 20% per year and accidents by 20%. Such need for change does come against a backdrop of an industry that suffers from an 'image' problem. Table 1 shows that Murphy continues to blight projects.

Project Risk and Uncertainty in the Project Process

No construction project is risk free. Risk can be managed, minimised, shared, transferred, or accepted it cannot be ignored' (Latham 1994). But contractors rarely quantify uncertainty and systematically assess the project risks (Al-Bahar et al 1990). Indeed, Flanagan and Norman (1993) recognize that the risk management in construction is poor compared with other industrial sectors. Akintoye and MacLeod (1997) suggest this is due to contractors and managers lacking knowledge of risk

management techniques To combat this predicament, Reid (2000) suggests that senior site personnel should, on a daily basis, ask 'what could go wrong on this job today'.

Heathrow Express Tunnel Collapse (1994)	British Library (London)
HSE reports errors were made 'leading to poor design and planning, a lack of quality during construction, a lack of engineering control and most importantly a lack of safety management' (New Civil Engineer 2000).	300% cost overrun and quality problems with electrics, wiring and sprinkler system. The Public Accounts Committee said it as a 'model of how not to manage a major construction project'. (Construction News 1997).
London's Guy's Hospital (Phase 3)1997	Cardiff Millennium Rugby Stadium
Completed 3 years and £68.7 m over budget, blamed on failure to freeze design, significant design changes, delays to works packages, major package contractor(s) insolvency and corrosion of copper pipework requiring £3-5m replacement cost (Contract Journal 1998)	Contractor Laing go £26m over budget due to committing to GMP while design undergoing major changes. Row between client and its neighbour also led to major design changes (Building 1999).
Thames' Millennium Footbridge	British Museum
£18m bridge close shortly only days after opening after huge crowds caused it to sway violently. Bridge is likely to be closed for a year while £5m solution is retro-fitted.(Contract Journal 2000b)	A Portico was restored using French limestone rather than the more expensive British Portland stone which matches the courtyards existing fabric (Building 1999).

Table 1 Murphy was here!

Smith (1999) recognizes that the terms 'risk' and 'uncertainty' if used rigorously, have different meanings, but that in construction projects the difference will have little significance and that they are commonly used interchangeably. The construction industry has adopted many methods in attempting to reduce uncertainty in the process. The use of 'apparently' standard forms of contract is intended to rationalize the construction process. Project planning with its associated Critical Path Networks is another example as are the use of BS5750 and today ISO 9000 quality procedures. Other techniques used to reduce uncertainty include the application of time and motion study principals to construction and its recent predecessor developed by the Building Research Establishment in the UK, CALIBRE (Vassos 2001). In addition, the UK industry can be seen to have extended its capabilities in this quest, and largely as a result of the 'Egan' report, now embraces a 'learning culture' vis-à-vis' such initiatives as benchmarking, demonstration projects and Key Performance Indicators (see M4I web site). Furthermore, new procurement philosophies such as 'Prime Contracting' (Holti et al 2000) lean construction and Supply-Chain-Management are all intended to eliminate wastage (time, materials, money, labour) by denying Murphy a visit to site and thus reducing uncertainty in the construction process.

Selection of Optimum Procurement System (Keeping Murphy Out!)

For a number of years many UK construction clients have demonstrated their unhappiness with the capabilities offered by the construction industry and available procurement systems (Contract Journal 1999). Such availability of choice does however suggest that clients can recognise the difference and benefits between each procurement method. For example, property developer Hammerson UK Properties use Design &Build for simple contracts, an amended version of JCT 80 (traditional) for contracts between £10-15 million and anything above this figure is procured through construction management (Construction News 1997b). However, Hall (2000) thinks that some clients are wasting vast amounts of money and experiencing long delays because they are not educating themselves on how to choose the right method of procurement. He suggests that 'too many clients are using JCT contracts even if it is not the most appropriate'. Indeed, Cain (2000) suggests that radical reforms taking place in the industry can be easily blocked by clients. Cain notes that 'procurement arrangements of many clients still continue to reinforce the structural failings of the industry'. However, as will be seen below, the assumption that a particular procurement / contract strategy can guarantee project success is by no means failsafe.

The definition of whether a project is a success or a failure is not always an easy one (Morris and Hough, 1996). Indeed, projects are often termed a technical success despite being behind schedule and over budget. Conversely, projects may be ahead of schedule and under budget but still be a technical failure (Larson and Gobeli 1987). Of more significance, Bresnen & Haslam's (1991) research with a 138 experienced clients revealed no significant association between the type of contract / procurement system used and project performance (time, cost, delay). Moreover, in reviewing many studies of this topic they argue that there is no great weight to the argument that any one method will help guarantee improved performance or greater satisfaction, at very best, the results are inconclusive and ambivalent. Liu and Walker (1998) also cast doubts on previous studies regarding the evaluation of project outcomes and observe that the concept of project success has remained ambiguously defined and can lead to disagreements between project participants.

Murphy Makes a Site Visit:

The cost of 'making good' Murphy's mischief can be excessive. Table 1 indicates some of the heavy financial penalties that can have an impact on companies involved in projects that go wrong. Much of the additional costs attributed to such projects involves rework. Love and Li (2000) found that during the construction stage of two case study projects in Australia, rework arose out of incomplete and erroneous project information. Josey (1998) in referring to the defects in the construction of a new hospital building blames 'careless and sloppy working practices' and argues that the high level of subcontracting in the UK has resulted in bad buildings, dissatisfied employers and writs. Such inefficiencies are noted by Taywood (1997) who suggests that the construction industry has a particular culture in which defects are tolerated via practical completion certificates, post-handover snagging and defects liability periods. Such criticism of the construction industry seems to suggest that many of the quality improvement slogans (i.e. get it right first time, zero defects, quality built in and continuous improvement) are indicative of the wide use of rhetoric in construction

Research Methodology

11 projects in Central Scotland were selected to be representative of the various procurement routes (Traditional, D&B and Management methods) in order to collect data for the study. The study was longitudinal, recording events recalled by the main project actors during the construction of each project. These main project actors or 'Elite' members (Marshall and Rossman, 1995) of the design and construction team (i.e. Client, Architect, Project Manager, Contractor, QS, Services & Structural Engineers) were interviewed on a number of occasions. The actors were requested to recollect project incidents which they regarded to be either project enhancing or detrimental. The Critical Incident Technique (CIT) of data collection was used (Flanagan 1954), although like Hussey and Hussey (1997) this research technique was initially employed without realising its origins. Project incidents were recorded using short hand note taking. The notes were 'typed up' after each interview and it was often at this time that other recollected data was put to paper. Sonnewald (1996) also used this approach in combination with the CIT to collect data. Gabriel (1998) also comments on this particular method of data collection (recollection) and suggests that it is a 'legitimate' method, especially when stories are committed to paper shortly after they were heard. After several visits to the case study projects it became necessary to develop a framework for the analysis of the data (critical incidents). It became evident that the incidents had recurring themes and were a result of internal project issues (typologies 1-9) and external events having an impact on project performance (typologies 10-14).

Case Study	Procurement Method	Project description
1 (pilot)	Management Contracting	Exhibition and Conference centre
2 (pilot)	Design &Build	New Multi-storey office building
3	Design &Build	New Build city centre Hotel
4	Traditional	60 Bedroom extension to 4* Hotel
5	Design &Build	Leisure Complex with multi-client units
6	Traditional	Conversion of 'old' city centre hotel into retail units
7	Traditional	'Fit-Out' of completed 'shell and core' office building
8	Traditional	Construction of new sports hall for a University client
9	Construction Management	Extension and Refurbishment International Airport
10	Traditional	New Build 4.5* Hotel in city centre
11	Design &Build	Construction of new office building (low rise) on green-field site.

Table 2 Case Study Descriptor

It was decided to formulate these issues into a typology framework, the results of which are shown in Table 3. The procedure for establishing, into which type each incident would fit, was essentially a pragmatic one. Notes were scrutinised after each interview and allocated a position.

	Case study																					
Typ	1		2		3		4		5		6		7		8		9		10		11	
	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E	D	E
1	21	2	12	5	20	3	14	2	6	0	4	1	9	0	8	0	2	3	3	0	2	0
2	3	1	1	0	2	2	0	0	0	0	0	1	0	0	1	2	0	1	1	0	0	1
3	6	0	6	1	19	2	16	2	18	1	7	1	15	3	17	3	7	3	5	3	6	3
4	7	1	6	4	5	11	3	3	11	1	5	0	9	4	5	6	2	6	3	1	0	0
5	14	3	14	3	16	5	10	2	14	1	8	1	11	2	11	4	7	0	5	0	8	2
6	25	1	16	5	11	6	8	0	9	0	3	0	16	2	14	1	4	0	9	1	16	2
7	6	0	1	0	5	1	2	0	20	0	0	0	11	0	3	0	0	1	0	0	2	2
8	8	0	16	8	13	5	5	2	7	0	4	0	6	1	21	5	1	0	2	1	4	0
9	14	0	6	8	7	0	4	0	4	0	3	0	9	0	12	2	1	0	3	3	6	0
10	3	3	4	1	3	1	1	0	3	0	0	0	1	0	1	0	5	0	0	0	0	0
11	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0
12	2	0	3	0	0	0	3	0	12	0	2	0	0	0	2	0	0	0	2	0	1	0
13	6	0	5	0	3	0	1	0	3	0	0	0	1	0	1	0	2	0	0	0	0	0
14	6	0	2	0	6	1	7	0	19	0	5	0	18	1	9	1	2	0	3	1	7	0

(1+15) Location of team members **(2+16)** Effectiveness of team member **(3+17)** Team working **(4+18)** Communication issues **(5+19)** Design / detailing issues **(6+20)** Organisational politics **(7+21)** Supply-chain management **(8+22)** Sub-package integration **(9+23)** Project location **(10+24)** Historical trade loyalties (Edinburgh mafia etc) **(11+25)** Macro-economic pressure**(12+26)** Building and Planning control issues **(13+27)** Client Internal Issues **(14+28)**

Table 3: Case Study Typology

It can be seen that the majority of incidents fall under 'project detrimental' issues (D = project detrimental) and thus the purpose this paper on Murphy's Law (It is worth noting that Morris and Hough (1987) discuss whether one should study project successes or failures). It should be noted however, that all interviewees were encouraged to recollect incidents that demonstrated a successful project (E= project enhancing). Indeed, many of these incidents recalled did in fact have an element of 'duality' to them. Thus, a problem, which by its nature tended to have a detrimental impact on the project (in terms of cost, time and performance) would on some occasions also present a window of opportunity to improve the project process. In addition, the allocation of a project incident (scoring) to the typology also includes multiple listings. For example, an incident which would be initially scored under a design / detailing category may also have been the result of communication and teamwork problems and would thus be scored under all three headings. On completion of each project, a method of visually conceptualising the critical incidents recorded was thought necessary. The intention was to provide both the research team and the interviewee's with a 'pictorial descriptor' of the perceived project enhancing and

detrimental qualities. The conversion from tabular form into a histogram was used and thereafter recorded as a 'project footprint' (see Figure 1).

Results and Discussion

It is not the intention here to conduct an exhaustive analysis of all detrimental incidents in each case study project. It can be seen from Figure 1 that in each case study detrimental column the 4 highest numbered boxes have been selected (shaded). It should be noted here that the difference in numerical terms between each box (case study) is not under discussion and does not form the basis for inter-case study analysis. The number of interviews conducted on each project was not evenly distributed as a result of difficulties in gaining regular and continuous meetings with individual project actors. Thus, the quantity of recalled incidents cannot be used as a measure for analysis or indeed as an indication of project success or failure. Table 2 shows a typology hierarchy based on selecting 4 commonly cited incidents (highest totals) in each project. Each typology is discussed and reference is made to the procurement system adopted in each project.

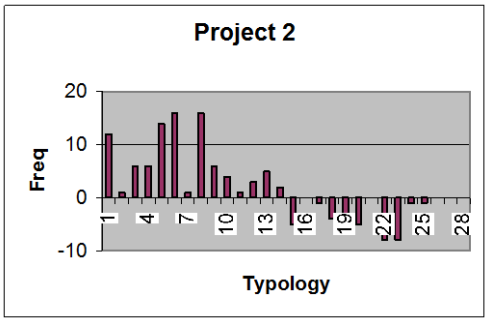

Figure 1: Example of Project Footprints

Communication Issues

It is perhaps not surprising that all 11 projects should have suffered from this problem given that it has been frequently cited as being a weakness in construction. As early as 1965, Higgin and Jessop showed communication difficulties existed at several levels in the industry. Particular difficulties relevant to this paper are firstly, communications in the design team; secondly, contract related communications; finally construction team communications. Recently Boudjabeur and Skitmore (1996) provide details of untimely, inaccurate and insufficient information in D&B projects. With regards to this research, several communication difficulties are worthy of comment. The client in case study no.7 developed a project organogram to be used by the project team as a communication structure 'aide-memoire' during the project. This document acted as a buffer between the internal clients and the project team and to smooth problems in communication roles. This was however abandoned early in the contract (by the client) due to changes in personnel within the client body. The majority of communication difficulties did however involve inter-personnel issues between project team members.

Actors (project No.1) had problems maintaining contact on some projects and paradoxically even where teams were co-located on site (project No.6) communication problems were evident. Many communication problems were reported at contractor-sub-contractor-Architect design interface(s). The tendency for projects to involve sub-contractor design input (not withstanding the D&B projects) manifested itself in 'grey' areas of role and responsibility for design detailing. The impact of such insufficient design information only becoming apparent at construction stage. Such conditions in themselves were seen to generate further requests by the contractors for design details during construction with the resultant 'as built drawings' being finalised post construction. This situation in itself is endemic within the industry and is clearly not appropriate in a culture where 'rethinking construction' is taking place.

Typology	Traditional (out	D&B (out of	Management (out	Total (out of 11

	of 4 projects)	5 projects)	of 2 projects)	projects)
Communication	4	5	2	11
Effectiveness of Team Members	4	4	1	9
Design / Detailing	3	3	2	8
Roles & Responsibilities	2	3	1	6
Client Internal Issues	2	2	0	4
Supply-Chain Management	1	2	0	3
Organisational Politics	0	1	0	1
Sub-Package Integration	0	0	1	1
Project Location	0	0	1	1

Table 2: Case Study Hierarchy of Typologies

Effectiveness of Team Members

This category is used to emphasise where construction team members have performed in a less than satisfactory manner. It s to some extent an extension of typology no 3 (Team working) but relies heavily on a judgmental perception which the researchers have of the incidents cited in the interviews. In addition, interviewees would often apportion blame at each other and this has also been scored. This typology essentially takes the view of 'if only the actors had behaved in an optimum manner' this problem may not have arisen. It views each case study project as being devoid of organisational, institutional, personal, contractual and procurement boundaries and categorises the 'mistakes' made by the actors. As noted earlier in the paper, many of the incidents are scored under more than one typology and this category therefore includes scorings, which have also, be taken into account under typologies 1, 2, 4, 5, 6, 7, 8, and 9.

Design Detailing Issues

Due to the nature of constructing a hierarchy of typologies in Table 3 it can be seen that 8 of the case study projects suffered from design / detailing problems. However, reference to Table 2 will show that all of the eleven projects were in fact blighted with such conditions. Two projects (3 and 10) demonstrate such an issue in that they were both designed 'on the hoof' so to speak. Both these hotel projects were originally to be 3* and 2* category respectively and were designed as such. However due to case study no 3's project location (close to now confirmed new Scottish Parliament) and change in clients brief in case study no. 10 (from backpackers hotel to quality accommodation) both these projects involved significant design changes when they were upgraded to 4* hotels. In both cases it was left to the contractor to chase design information. Since both these projects were used D&B arrangements this was to be expected. However, given the difficulties which developed in co-ordinating work packages as a result of missing information it does emphasise the unsuitable nature of D&B procurement to projects where design briefs change significantly from prevailing socio-economic conditions.

Roles and Responsibilities

Several construction writers have commented on the difficulty in detailing roles and responsibilities in projects. Bennett (1985) notes 'conditions of engagement' prepared by each professional institution (CIBSE, RIBA, CIOB, RICS etc) are typically used to detail what services the client receives from each consultant. However, and to the detriment of teamwork, these conditions standardise the obligations to the client, not between the other project parties. Murdoch and Hughes (1996) argue that this situation misses the value of teamwork and how fragmentation created by terms of appointment compromise this. Hellard (1995) also comments on such confusion when he notes that that those engaged in building are 'frequently left to work out their own objectives'.

Only one case study project (no.9) had instigated a project procedure manual describing roles and responsibilities 'expected' of participants. However, given that this

experienced construction client has in many ways championed the reforms demanded by the 1998 ‘Egan’ report this should not be so surprising. Such control over the project process was not evident on any other project. Actors were assumed to know their role and how to do their job. The main contractor in case study no. 3 did develop a series of teambuilding workshops as part of the partnering philosophy on the project. The initial workshop involved the project team completing the Myers-Briggs psychological test and developing a communication protocol for the project. This approach to building a team can be contrasted with case study no. 11 where the close knit nature of the team gave a flexibility in the roles and responsibilities demanded within a construction project. The team on this project had worked together on several projects for this client before and had built up amicable relationships with one another. On several occasions actors referred to not 'dropping [him] in the shit!’ It was understood that they would meet again on future projects (for various clients) and that they had sour future co-operation by accusing one another of incompetence. An unwritten and informal (or gentleman’s) code was thus enacted whereby the team would sweep up any problems which arose due to fuzzy areas concerning responsibilities. Interestingly some clients are frightened of such team cohesion and perceive it to acting as a cartel against their best interests. The client in project no.9 for example referred to the ‘Edinburgh Mafia’ and had commissioned an English project manager to keep an eye on his interests.

Client Internal Issues

The range of client experience with construction procurement in the eleven case study projects ranged from experienced to very experienced. That is to say no clients were novel to this industry. In particular, two projects were beset as a result of Murphy adopting the guise of a client. Project no. 5 involved the contractor working under a D&B contract for a property developer. Difficulties arose in this client body when the ownership (ergo risk) of the project changed hands at half way through construction. In addition, the multi-outlet nature of the building resulted in different sub-clients wanting late design variations on many occasions. The additional cost and time attributes exacerbating the already politicised nature of this project. Moreover, at least two members of the design team were also acting as consultants for these sub-clients clients and thus wearing ‘two hats’ on the project. This put a large strain on the established protocol of a novated D&B project and many instances of ‘grapevine’ communication took place. It is interesting to note that a new KPI has been established to monitor such client led design changes. Termed, ‘change orders’ it will allow contractors to pinpoint who is to blame for delays or cost increases in projects (Contract Journal 2000a).

Project no. 7 also presented difficulties for the project team as a result of what may be described as inappropriate client behaviour. The original plan on this office ‘fit-out’ project was for the clients’ internal project manager to act as a buffer (between internal client departments and design & construction team) and be the clients sole communicator with the project team. However, this manager was moved to another part of the client organisation (and not replaced) with the result that the project management consultancy employed by the client were now responsible for co-ordinating all internal client change requests. Again, in similar to the above project, these were many, and often in conflict with one another thus demonstrating how a power struggle within a client organisation can impinge on the smooth running of a project. Both of these projects suffered as a direct result of sub-optimal client intervention. Perhaps this should not be so surprising as Thomas (2000) argues that too many clients want ‘something for nothing’. He puts the blame for constructions inefficient and dispute orientated culture firmly at the feet of clients by suggesting that they have got the

industry they asked for. However other clients such as a representative of a regular purchaser of new office buildings has criticised construction for inadequate design, poor information, delayed handovers and defective work (see Ward 2001) and thus it can be seen that a culture of 'contractor bashing' continuous to exist.

Supply-Chain Management (SCM)

In the wake of the Egan (1998) report, Supply Chain Management (SCM) has become the 'flavour of the month'. Egan identified SCM as being a historically weak function in construction with overly confrontational relationships between project participants. The hard bargaining 'we don't give them an inch' or 'they don't make a penny on this project' mentality inherent in construction is often a source of great pride amongst construction professionals. Since Egan and other authors have noted particular problems in construction SCM, it was anticipated that such problems were likely in the case study projects selected. Indeed it was unsurprising when SCM became a significant issue in three (No's 2, 3&8) the projects investigated. Although both Project 3 & 8 did have SCM issues arising, Project 2 could be considered the 'pinnacle' (in so far as the word can be used in the context!) of how NOT to organise a project for SCM.

The pre-amble to the catalogue of disasters came about through the inability of the clients to settle on a procurement route. The project started by being a management contract; but the contractor was taken off the job when the project director decided to go to a rugby international match in preference to going to a meeting with the client! Subsequently a traditional contract was drawn up to govern the project, but again this too was superseded before finally a D&B contract was selected. Ultimately a single decision made early in this procurement process created catastrophic effects in the supply chain and on the delivery of the project overall. As part of a design feature of the building, the in situ casting of the concrete vaulted ceilings required the manufacture and delivery of precisely detailed and sized fibreglass moulds. These moulds also had to be delivered on time and in the correct order to facilitate the construction process. Only two companies tendered seriously for the contract to supply these moulds; one was large and well known in the industry for having a high level of expertise in the particular speciality. The other company to tender was much smaller with no 'name' in the area, but who did offer a substantially lower unit cost in order to win the contract. Unfortunately the decision was taken to select the 'low cost' contractor to manufacture the moulds. These moulds immediately became the critical component in the process, without which operations on site stopped. Frequently the moulds were delivered out of sequence, late and in too few numbers to allow a concrete pour. As the programme slipped behind schedule and the contractors put as many men on the site as possible to speed up production, they could do nothing without these moulds.

Impact of Selected Procurement System

What should be clear from the above discussion is that Mr Murphy makes no distinction as to which project he will visit next. Each project was beset with a number of incidents, which resulted in some form of time, cost and quality wastage. The procurement system adopted (and in most cases adapted and thus 'hybrid') did not form a boundary or shield to these problems. Indeed, it could be argued that the adoption of a formal risk management framework (no project had this) on each project would not have prevented the projects being exposed to the trickery of this Irishman. What however is evident is that each case study project investigated operated under a named procurement route. However, the group behaviour of the actors during the project process would appear not to be determined by such formalities. For example, if we look

at Table 3 it can be seen that the most common incidents to arise on projects involved issues involving communication; effectiveness of team members; design / detailing and roles & responsibilities. Very little distinction can be made on comparing these between the different procurement routes used in this study. These issues are however perhaps the key to project success and it is interesting for example that new forms of procurement (i.e. Ministry of Defence Prime Contract) has developed out of the behavioural research undertaken by the Tavistock Institute (Holti, 1997; Nicolini et al 2001). Indeed, a recent quote from a construction management provider can be seen to lend support to this thesis; 'it revolves around a building, [service offered to a client] not getting hung-up on the procurement method' (Paxford 2001).

Conclusions

Josephson and Larsson (2001) suggest project errors (a visit from Murphy) happen recurrently and to avoid old errors, people must learn. This emphasises a need to collect and disseminate knowledge (i.e. Knowledge Management) within and between projects and organisations. It also emphasises the human dimension to increasing the likelihood of project success. However, although U.K. construction is making headway with reducing repeated failures in projects (i.e. KPI's, CALIBRE and Demonstration Projects etc) no projects examined here demonstrated a culture of continuous learning. The issues discussed in this paper have been addressed, on occasions, quite whimsically (playing on Murphy's Law as the root cause of project problems). Although wastage (time, materials, labour etc) attributed to Murphy's site visits has not been quantified in this study, the results have serious ramifications for the construction industry. Indeed, the call for a 'sustainable' construction industry (DETR 2000) must surely be in jeopardy if the majority of projects undertaken in the UK cannot meet the requirements of Egan's (1998) agenda for change. However, let us not be complacent and regard projects claiming to have 'zero defects' as being free from Murphy's work. UK construction cannot benefit from projects which are handed over 'defect free' but which huge wastage during their construction. This is to deny Murphy's work and could be said to be akin to 'spin doctoring' the reality of the industry.

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