Delivery of projects on time and within budget with the required quality and safety is paramount in all businesses. However, there is still a high frequency of projects that are late and over budget. Recent examples of these include the new Wembley stadium and the Scottish Parliament building in Edinburgh.

The aim of the research work is review the current techniques that are used to plan and control projects with the objectives of identifying innovation and project control processes that improve control and delivery of projects.

This paper presents the approach establishing current practice in a variety of industries e.g. Oil and Gas, Nuclear, Pharmaceutical, Building Construction, Transport and Petro-Chemical. In order to establish the current practice for control, a questionnaire was developed identifying 50 key questions of how project controls are carried out and > 20 companies were interviewed with regard to their processes. The results were analysed to establish how each element of project controls was utilised in each of the different industries. Tacit knowledge gained in particular from Oil & Gas and Pharmaceutical industry is also being recorded to determine for example best practice and transfer of best practice and –processes between industries.

The final outcome of the research will be to develop and test road-maps that would identify preferred project control appropriate for different industries/projects or portfolio’s of work.

KEYWORDS: Project management, Oil & Gas, Planning,

OVERVIEW

The Project Management Institute (PMI, 1996) defines a Project as any undertaking with a defined starting point and objectives by which completion is identified. (A Guide to the Project Management Body of Knowledge, 1996 P4). The primary objectives of Project control are to deliver a project within budget and on schedule, with the level of quality and workmanship as stated by the client in the contract. To achieve these objectives teams need to have systems, processes and procedures which reduce or eliminate those functions that increase costs and duration of projects. The design of a project control is an important part of the project management effort Shtub, Bard and Globerson (2005).
Many articles have supported the importance of control in the achievement of the project aims. Project performance can be improved if more detail is given to the issue of Control (Avison, Baskerville and Myers 2001).

Although delivery of projects on time and within budget and with the required quality and safety is paramount to all businesses, there are still a high frequency of projects that are late and over-budget. Recent examples in the UK include the New Wembley Football Stadium and the Scottish Parliament building in Edinburgh, Scotland.

Also, the paper’s authors had many examples of cost and time over-runs in a variety of industries including Oil & Gas, Nuclear, Chemicals, Roads & Transport and Petrochemicals. This tacit knowledge and experience identifies many positives and shortcomings in the control of projects that resulted in cost and time errors.

In this context, the aim of this research project is to investigate current processes, systems and procedures that affect the delivery of projects in the heavy civil engineering which include Oil & Gas and Pharmaceutical construction and installation. The ultimate objective is to develop roadmaps that would assist project managers to identify preferred project control appropriate for different industries/projects or portfolio’s of work.

The Research Project had four phases:-

- Literature Review – this will establish areas of best practice and areas of concern.
- Development of Questionnaire and Collection of Data from various sectors of Business.
- Analysing, comparing and contrasting Project Control Practices.
- Development and Testing of Tools towards Roadmap Guidelines. The data that is collected during the research will be used to develop “roadmaps” which will provide guidelines to improve the Project Controls and avoid project delays.

This paper provides a summary from the research investigation that examined Project Controls. In detail it reviewed the following activities:-

- Cost Control/Work Breakdown Structure
- Estimating
- Cost Control
- Schedule Control
- Critical Path Planning/Completion date
- Change Control
- Reporting

The above reflect the core requirements of a robust Project Control system.

**Research Objectives**

The objectives of Project Controls research were to :-

- Carry out a detailed literature review, review considered best practice, what others are doing and common causes of failure.
• Collect data from a variety of industries on how Project Controls was utilised and which systems, processes and procedures were utilised.

• Examine and analyse the data to establish trends, common problems and issues, also to determine if there was any co-relation between the various aspects of control failings.

• Develop a road map based on best practice and innovation in order to demonstrate improved systems, processes and procedures to enhance delivery of projects.

**Purpose of the Research**

For this research an investigation and evaluation of current industry practices related to Project Controls was carried out. The purpose of the research was to investigate Project Control processes in a variety of industries, compare against “best practices” and develop a “road map” which, if followed, could help improve the Project Control process. This would help to improve Project delivery and improve cost and schedule over-runs.

**Methodology**

The methodology used for completing the first objective of project controls research included studying information on project controls to determine the types of issues which were arising in industry. Also to determine best practice and ascertain what worked well in different industries.

A questionnaire containing 55 questions was developed to collect data on project controls. It was discussed in detail with 24 companies at a Project Control, Planning Engineer, cost Engineer and Project Manager level. The industries covered Nuclear, Pharmaceutical, Oil & Gas, Petrochemical, Buildings and Transportation. The value of work covered in the survey was in the order of £4 – 5 billion. The survey participants were also requested to provide recommendations on how systems, processes and procedures could be improved. The questionnaire structure is given in appendix A of this paper.

**Results and Analysis**

Survey participants comprised the following industries:

- Oil & Gas: 4 responses
- Pharmaceutical: 3 responses
- Nuclear: 4 responses
- Buildings and Construction: 4 responses
- Transport and Roads: 3 responses
- Chemical/Petrochemical: 6 responses

The following section discusses the responses and analyse the results, and appendix A shows the questionnaire list and the question that were asked in each section.

**Cost Control and Estimating**

Figure 1 shows responses of the cost control and appendix A shows the type of questions that were asked. The key observations from the cost control responses were:

• Changes not monitored, therefore surprises at the end of the Project.
• The need for increased updating of the budget.
• Cost control to be managed by cost engineers.
• Wrong resource managing cost control.

It is interesting to note that the wrong resource was quite often seen as a potential problem when controlling costs. Yates and Eskonder 2002 advised that “assigning the project to the wrong person” was a major factor in lack of control.

**Figure 1: Responses from cost control and estimation questionnaire.**

Key observations and recommendations for improvement for the estimation processes were:

• Benchmarking previous projects and using the data for new project estimates.
• Improve quality of estimating personnel.
• Have a formal estimating system in place including norm values.

**Schedule Control**

Figure 2 shows results from schedule control questions. It is interesting to note that 14% of the personnel who completed the questionnaire advised that control of the project was impaired as a result of poor planning.

Key points derived from the research are as follows:

• Inexperienced Project Managers who do not see the benefits of good planning.
• Planning training required for Project Managers and Engineers.
• Robust procedures in place.
• Baseline of the Project Plan.
• Buy in to the plan from management.
• Culture of industry is not conducive to best practice planning.
• Contractors to be aligned to client’s needs and best practice.
• Client to have more involvement with contractor’s planning.
• Use of standard planning software appropriate to the project requirements.
• Inexperienced Planning Engineers.
• Change control process to be implemented.
• Better integration between design and construction teams.
• Consider the use of visualisation 4D planning systems.

The need for a standard planning process was addressed in the paper – Effective Project Planning Techniques in the following statement “By adopting consistent procedures before a project begins, all parties can help eliminate costly assumptions and assure greater consistency and integrity in the use of the project schedule”, Jensen, 1994 p. 66).

![Fig 2 Schedule control](image_url)

**Change Control**

Figure 3 shows schedule control summary analysis. The research indicated that almost 80% companies were using some form of change control process.

The major observation was that several organisations tracked changes from a cost management perspective but took no account of the impact of change to the schedule.
The research indicated the following key issues, with regard to Project Reporting and Reports:

- Contractor’s reporting needed to be in a standard format.
- Reports needed to be automated using planning and cost management tools.
- Planning and cost engineers using different cut off dates for reporting.
- Progress information not interrogated to establish trends and corrective actions.

KPI’s and Earned Value Calculations

The use of KPI’s and Earned Value calculations where discussed with clients and the following observations and recommendations were made:

- 75% of clients were using EVA.
- 15% of clients’ Project Control Specialists wanted client managers to implement EVA measurement.
- 10% of clients regarded EVA as “not required”.

The use of the EVA principals to examine work performed cost versus budgeted cost is described in many text books, e.g. Sipper and Buffin, Raby 2000, Fleming & Koppleman 2000. EVA is recognised as a very common methodology for Project Control.

Industry/Cultural Effects on Project Controls

The research indicated that in keeping with Tacit Knowledge the North Sea Oil & Gas Industry was a “mature” Project Control model. The model developed and honed by North Sea operators and their major contractors in the 1980’s was developed to ensure effective cost and schedule control of the £ billion investments to ensure timely completion within budget.

The culture of effective control was driven by a number of factors:

- Return on Investment driven by the need to achieve oil and gas sales within a specified timeframe.
• Gas and Oil sales agreement established in advance with severe penalty payments.
• Heavy lift cranes booked 2 years in advance to install Jackets and Topsides in the North Sea. The need therefore to have construction completed on a specific date.
• £1 billion investments with several partners all of whom are themselves tied into finance agreements.
• The oil and gas industry also attracted top class practice specialists who were driven to provide good project controls. Hire the best people Cooper & Els (1997) studied one programme that cut off 25% off the schedule and 39% of the manhours from this one factor.

The culture developed as a result of the above factors was responsible for the introduction of many enhancements in Project Controls. The enhancements in project controls developed in the 1980’s have since spread into many construction companies and other industries. The systems included :-

• Procedures for Cost, Planning and Estimating
• Effective schedule development
• Procurement schedules
• Design interface schedules
• Look ahead schedules
• Progress measurement innovation
• Productivity calculations
• Reporting techniques and corrective action techniques
• Change Control Procedures developed
• Improved Cost Management Processes
• Estimating techniques aligned to scope definition and cost control
• Integration of contractor’s procedures, systems and processes

“Differing cultural factors in businesses can also influence how development and implementation of systems can be carried out. Cultural factors may include company history and tradition, lender influence, technology, industry competition, legislation and company environment, missions, visions, value and beliefs, organisation and resources”. (Goodman 1997).

Also missing from Goodman’s list is Commercial Drivers, i.e. sales agreements and rate of return on investments.

The collection of data via the survey indicated that some industry’s project controls approach was influenced by different cultures from that shown in the oil industry for example.

**Conclusion and future research**

Analysis of the data has identified methods and processes that work and those that do not within the various sectors of business. Armed with this information coupled with tacit knowledge and many years’ experience within projects and project controls we can then develop a model/toolkit/road map to demonstrate how to improve Controls and Project delivery. We need to be mindful, however, that not all projects/businesses are the same and that no single set of techniques can be universally applied.

These tools will be based on, for example :-
• Process flow sheets
• Improved procedures/guidelines
• Software recommendations
• 4/5 D planning software
• Training considerations
• Knowledge management
• Industry needs (which may be different for each sector of Industry)
• How we can transfer knowledge and processes between industry sectors
• Best practice considerations from experience and literature review
• Theory of PMBOK
• Organisational cultures

Following the development of models/toolkits/road maps it is then possible to review processes with live programmes and projects.

References

Cooper Kenneth Co & ELS Sharon (1997 Oct) Failing to Learn – Learning to Fail OLCA/TIMS Conference, Dallas, TX.
Sipper D and Buffin R Production Planning, Control and Integration, New York, McGraw Hill.
### APPENDIX: PROJECT CONTROLS QUESTIONNAIRE

**A = STRONGLY AGREE, B = AGREE, C = NEUTRAL, D = DISAGREE**

#### General information

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<th>A</th>
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<tbody>
<tr>
<td>1. HAVE PROJECT GUIDELINES, PROCEDURES AND TOOLS BEEN PRODUCED, REVIEWED AND IMPLEMENTED FOR PROJECT CONTROLS.</td>
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<td>2. HAS APPROPRIATE TRAINING TAKEN PLACE PRIOR TO IMPLEMENTATION.</td>
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<td>3. ARE THE DISCIPLINES OF COST CONTROL, PLANNING AND ESTIMATING ALIGNED AND INTEGRATED VIA A OBS, WBS, CBS</td>
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**Additional comments**

#### A COST CONTROL

**WORK BREAKDOWN STRUCTURE**

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<tr>
<td>4. HAS A WBS BEEN ESTABLISHED AND ALL BUDGET COSTS CODED?</td>
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<td>5. DOES THE CODING SYSTEM PROPERLY INTEGRATE WITH THE PROJECT ACCOUNTS CODES?</td>
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<td>6. DO YOU CONSIDER THE WBS/CODING STRUCTURE IMPORTANT TO YOUR PROJECT(S)</td>
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**Additional comments**

#### ESTIMATING

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<td>7. Is there a build-up to each element of the original budget?</td>
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<td>8. Has the estimate been checked and reconciled?</td>
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<td>9. Has the estimate made provision for risk via QRA and has this been used to set contingency levels?</td>
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<td>10. Has the estimate been updated at regular intervals to reflect changes in data and circumstances?</td>
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<td>11. How could estimating be improved</td>
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*Can you elaborate on the software tools that can be used and the value of such tools.*

**Additional comments**

#### B. SCHEDULE CONTROL

**SCHEDULE DEVELOPMENT**

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<tr>
<td>25. HAVE SCOPE OF WORK AND DELIVERABLES BEEN ESTABLISHED WITH PROJECT TEAM?</td>
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<td>26. HAVE RESOURCE REQUIREMENTS BEEN ESTABLISHED FOR EACH AREA OF WORK WITH THE PROJECT TEAM?</td>
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<td>27. HAVE LOGIC CONSTRAINTS, MILESTONES AND KPIS BEEN SET?</td>
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<td>28. HAVE PROJECT BASELINES BEEN SET AND RETAINED AS COMPARATORS? IS THE BASELINE USED TO MONITOR PLANNED V ACTUAL PROGRESS.</td>
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<td>29. HOW COULD WE IMPROVE SCHEDULE DEVELOPMENT, TO OBTAIN A BETTER MODEL OF THE CONSTRUCTION SEQUENCE/PLAN</td>
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*Can you elaborate on the software tools that can be used and the value of such tools.*

**Additional comments**

#### C. CHANGE CONTROL

**CHANGE ORDER SYSTEM**

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<tr>
<td>44. HAS A CHANGE ORDER FORM/REGISTER BEEN FORMULATED AND IMPLEMENTED ACROSS THE PROJECT?</td>
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<td>45. HAVE ALL COS BEEN APPROVED BY THE PM(S)?</td>
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<td>46. ARE CHECKS MADE OF THE COST/SCHEDULE EFFECT OF ALL COS?</td>
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<td>47. DOES THE CO SYSTEM WORK IS IT OF BENEFIT TO THE PROJECT, COULD IT BE IMPROVED IF SO, HOW</td>
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*Can you elaborate on the software tools that can be used and the value of such tools.*

**Additional comments**
### D. REPORTING

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<td>48.</td>
<td>HAS AN INTEGRATED PROJECT REPORTING SYSTEM BEEN ESTABLISHED? ARE REPORTS ISSUED MONTHLY FOR EXAMPLE?</td>
<td>A</td>
<td>B</td>
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<tr>
<td>49.</td>
<td>HAVE REPORTS BEEN ISSUED FOR, OR INCLUDE A SECTION ON, COSTS, PLANNING, CHANGE AND A PROJECT NARRATIVE?</td>
<td>A</td>
<td>B</td>
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<tr>
<td>50.</td>
<td>HAVE COMMITMENTS AND EXPENDITURE BEEN MONITORED?</td>
<td>A</td>
<td>B</td>
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<tr>
<td>51.</td>
<td>HAVE PROGRESS AND PERFORMANCE BEEN MEASURED AND REPORTED?</td>
<td>A</td>
<td>B</td>
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<tr>
<td>52.</td>
<td>HAVE RISKS BEEN IDENTIFIED, ASSESSED AND QUANTIFIED IN THE REPORTS?</td>
<td>A</td>
<td>B</td>
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<tr>
<td>53.</td>
<td>HAVE TRENDS BEEN IDENTIFIED?</td>
<td>A</td>
<td>B</td>
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<tr>
<td>54.</td>
<td>HAVE CORRECTIVE ACTIONS BEEN UNDERTAKEN AND THE RESULTS CHECKED AND REPORTED?</td>
<td>A</td>
<td>B</td>
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<tr>
<td>55.</td>
<td>CAN YOU DETERMINE THE BENEFITS OF THE REPORTING PROCESS, COULD IT BE IMPROVED?</td>
<td>A</td>
<td>B</td>
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Can you elaborate on the software tools that can be used and the value of such tools. Additional comments