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LESSONS OF MANAGING URGENT AND EMERGENCY ENGINEERING

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Abstract
Urgent emergency engineering has become increasingly important to avoid and repair crippling faults or damage to industrial and public service systems. This paper presents the conclusions from reports and case studies to set out generic lessons for the management of future urgent emergency projects for any industry or service.

Introduction
Disasters whether classed as 'natural' risks or 'man-made' demonstrate the sensitivity of business systems and public services to damage. The risks are not new, but the 11th September in the USA reminded us brutally that worldwide our systems and services are increasingly complex and interdependent, and so increasingly vulnerable. And once in use, every system tends to become required up to its full capacity. Speed in managing the work that may be needed to overcome or avoid even minor damage is therefore increasingly important.

The causes of major emergencies, crises and man-made and natural disasters, how to reduce their recurrence, contingency planning and the lessons of relief work are the subject of many publications and conferences (Carter, 1991; Chang, 1999; CIAO, 2002, Davis & Lambert, 1995; Housner & Chung, 1997; Kaplan, 1996; Ranous, 1995; Schiff (ed), 1995; UK Home Office, 1997). But comparatively little has been published on the lessons of experience of managing the work to restore industrial systems and public services after damage. Severe damage can require an urgent emergency project to replace a system or service after a major event. Similarly, the threat of major damage can require urgent emergency work to limit the impact of potentially catastrophic threats. These demands can overwhelm the resources at hand for maintenance and servicing. They are unexpected. Over and above risk management, they test 'governability', the ability of organizations to respond to large unanticipated events (Lessard, 2000; Floricel & Miller, 2001). They require instant project management, and therefore immediate agreement on what is meant by 'urgent'.

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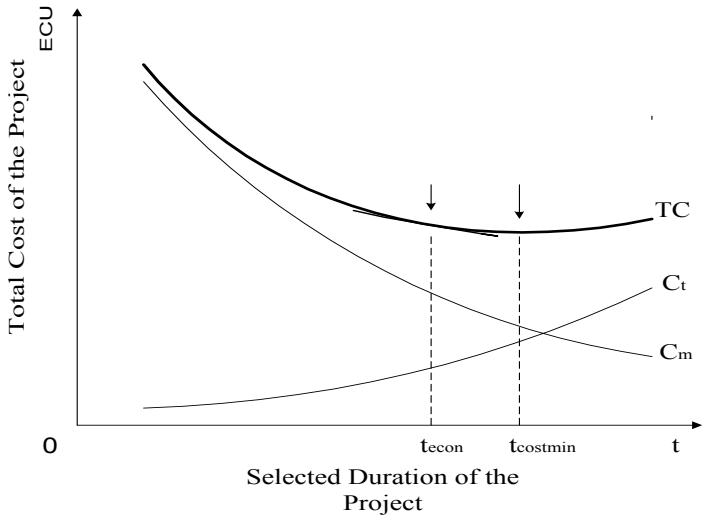
Urgency

Normally a new project in a business or public service is authorized because it promises to deliver value in return for its cost. The cost of a project can vary with the speed of delivering it, as illustrated in the figure. Some costs increase with the time taken, as indicated by the **Ct** curve in the diagram, for instance the financing cost of the use of resources. Other costs decrease, as indicated by the **Cm** curve, for instance the direct costs of resources. The sum of the two is shown by the total cost **TC** curve.

Relationship Between Duration and Cost of Project Execution



Continuous curves are a simplification in the figure. In practice the relationships may include step changes at choices in the number of people or the capacity of systems and machines which may be employed. In principle the relationship indicated between total cost and planned duration provides a basis for classifying projects in three distinct degrees of urgency:

Minimum Initial Cost - If the investor's requirement is to complete a project for minimum capital cost, its planned duration should be where **TC** is a minimum, the **tcostmin** point shown in the diagram. Urgency is zero. This is the condition for investment in services which do not earn or save money or are not credited financially for providing a benefit.

Economic Duration - If a project is to produce goods or services which are expected to earn a financial return, greater expenditure than minimum project cost is usually justified to try to achieve completion earlier than **tcostmin**. This point on the **TC** line is where its slope (shown by a tangent line) represents the discounted amount which is expected to be earned per week after completion (the slope of this line is negative, as it represents not cost but income per unit of time). Hence **tecon** should be chosen as the planned duration of the project.

Emergency - If speed overrides all consideration of cost, any attention to optimizing the use of resources is irrelevant. Time is priceless. Only physical conditions and resources limit the speed of work. Costs are recorded for accounting, but not for control. This is typical of a life-threatening situation in which the resources available are insufficient to preserve life. Uncontrolled the results become a disaster. These are the conditions requiring emergency planning systems.

What then is 'urgency' ? If the completed project is expected to earn a financial return, the total time to be allowed for its development and execution should be decided after estimating the likely cost of the project over a range of possible speeds of work and selecting the time at which the net present value of extra income obtained earlier by faster completion equals its extra cost. The same criterion should apply to a project which is expected to provide a social benefit expressed in financial terms. These projects should be planned to be completed in time **tecon**. If such a project is also stated to be urgent, this must mean that there is some non-financial reason for deciding to use resources uneconomically so as to try to complete it faster than in time **tecon**.

If the project is sanctioned as an investment in services which will not earn money or financial credit should be planned to be completed in time **tcostmin**. If it also stated to be urgent, this must mean that there is some non-financial reason for deciding to use resources uneconomically so as to try to complete it faster than in time **tcostmin**. In every case the word 'urgent' should therefore be defined in terms of authority to incur extra cost.

Case Studies

As only a few previous publications world-wide report the experience of managing the work for restoring systems and services after severe damage, six case studies were carried out to learn the lessons from those who have recent experience of managing emergency work for different 'regionally serious events' in the UK. Three cases were recovery work following serious damage to infrastructure systems, and three cases were preventative work to contain potentially serious damage (Wearne, 2002).

In the first three cases the first actions at the scene were those of life saving, safety and investigations of causes. The case studies covered the subsequent stage, after control of the scenes had been handed back to the asset owners.

Lessons of Managing Urgent Emergency Projects

If a project is defined as urgent emergency work, many of the established lessons of managing 'normal' projects are applicable, for instance the value of appointing an experienced project manager, establishing an agreed definition of objectives, employing a qualified team, implementing a project execution plan, controlling where the risks arise and regulating changes (Eastham, 2002; Eijkenaar, 1997). The differences are in the pace and style of relationships with stakeholders, project definition, authorisation, priorities, resourcing and control.

Recommendations on managing these differences are presented below. These are distilled from the case studies and the relevant previous publications. These recommendations are for asset owners and their project managers. They are checklists, not rules. Some of the lessons stated may be obvious, but all are included to make a complete list.

The Stakeholders

- Identify all stakeholders who may be affected by the emergency or by the work proposed for it.
- Assess every stakeholder's interests, their potential contribution and their priorities.
- Do not leave any stakeholder feeling excluded. Included parties tend to become helpers. Excluded parties tend to become hostile.
- Identify who in the key players' organizations have the authority to enter into unexpected commitments.
- Establish a stakeholders' forum for discussing and setting objectives and priorities.
- Help inexperienced stakeholders to recognize that the work requires the project mode of management.

Project Scope

- Appraise the total situation as soon as possible, in order to define the critical resources needed.
- Be quantitative about scope wherever possible.
- Concentrate on facts before preferences. People tend to see a need to do what they know how to do.
- Determine whether to restore to the previous or to a different standard or to an interim standard with built-in provisions for later raising to a higher standard.
- Recommend what may be needed to avoid recurrence of risks.

Project Authorization

- Ascertain who will authorize work and who will pay for what.
- Establish whether oral agreements will be honoured.
- Ascertain who will meet the costs incurred to others by the switching of resources from them to the emergency.
- Utilise accepted procedures.
- Be aware of different stakeholders' different interest in cost and value.

Priorities

- Ascertain what each party means by 'urgent'.
- Assess the reliability of predictions of threats that will demand emergency work.
- Investigate whether to provide a quick temporary restoration after damage.
- If resources are limited ascertain whether to give priority to completing sub-sections sequentially or all together later.
- Assess whether any party's definition of urgency is changing.

Resourcing

- Assess whether an emergency event is isolated or may be followed by repeats or knock-on events.
- Pace the first demands on key personnel. Don't assume that normal roles can be sustained in abnormal conditions (Abbott, 2002).
- Do not ask individuals or organizations to undertake work out-of-their depth.
- Allow for drawing off of resources to related events.
- Utilize others' emergency resources.
- Use familiar terms of employment for consultants and for contractors. Select those which are appropriate to the urgency and the uncertainty of the work.
- Employ key parties as partners.
- Dedicate a manager to marshal help from volunteers and charities.

Control

- Establish a clear strategy for the work.
- Establish systematic communications with all parties.
- Utilize individuals who understand how their organizations operate normally.
- Maintain continuity of control through shift working.
- Report through the usual channels. Do not truncate a hierarchy.
- Plan for the return to normality.
- Keep a diary. Record decisions and reasons. Photo frequently.
- Emergencies stimulate motivation and innovation, so note that procedures evolved in urgency may be of lasting value.

Discussion

Emergencies are rare events - they have to be rare to be socially and economically tolerable. Few people therefore have direct experience of them, but anyone may unexpectedly need to draw on that experience. Emergencies vary in their causes, the authorities involved, public concern, nature, scale, immediate resources available, uniqueness and location, but there are common characteristics and therefore potentially common lessons for anyone in future who has to plan and control unexpected work.

The purpose of this paper has been to present the lessons learnt in the form of recommendations for the management of any future urgent emergency work in any industry or service. They can be applied to man-made or natural emergencies. The recommendations listed are not rules. They are checklists, to be used as reminders of lessons to apply and lessons that can be ignored in a particular situation.

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