

# Applying the **empire** approach to emergency preparedness

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The empire benchmarking model is a new approach to assessing on-site emergency preparedness. Developed initially for and funded by the Health and Safety Executive in answer to the following questions:

- ▶ critical success factors for emergency management
- ▶ acceptable standards for emergency management training and competence demonstration
- ▶ methodology for evaluating emergency exercises and emergency management training

its aim is to target effort, regulatory and industrial, to achieve maximum value from investment in emergency arrangements.

OCTO is a specialist consultancy in crisis and emergency management. It has extensive experience, both operational and advisory, in major hazard industry. The empire model has been developed jointly between Octo and Cranfield University.

## How good do we need to be – and how do we know when we are there?

Clearly the fundamental problem is 'How good does industry need to be?'. The COMAH regulations and guidance offer some insights here, but remain by necessity generic in their approach. It was furthermore clear that a site with for instance 30 COMAH installations near a major centre of population was likely to require more demanding standards than a small gas handling terminal with (relatively) minor off-site risk.

The word relative is the key. The task was to develop a means of determining an appropriate standard of emergency preparedness for any particular site.

A second consideration was to avoid any challenge that the empire model represented the views of a single consultancy organisation. We therefore invited and were delighted to receive the enthusiastic response of a number of experienced players across a good cross-section of major hazard industry. All the sites who took part were major hazard sites regulated either under the COMAH regulations or nuclear site licensing conditions. They were:

Associated Octel; AWE Aldermaston; BHPP; BNFL Sellafeld; BP; BNFL Thorp; ICI; Pfizer; Scottish and Southern Energy; Shell; Urenco.

Each site shared with us its detailed emergency arrangements and subjected itself to an intensive and comprehensive assessment of its emergency preparedness. This comprised: site risks; philosophy of emergency response; emergency management structure; emergency organisation and facilities; emergency plans; team preparedness. In addition to reviewing documents and conducting interviews with key personnel, we watched an exercise, offered specifically as a demonstration of emergency capability.

## The **empire** model

In all over 4200 elements of emergency preparedness across 11 companies were assessed, with detailed commentary, and entered in a data-base model of emergency preparedness. The model is called empire 'emergency management performance indicators and risk

evaluation'. It uses a balanced score-card approach to assess 61 indicators of emergency preparedness across 6 different emergency management perspectives and two exercise assessment perspectives:

- ▶ emergency philosophy
- ▶ emergency management structure
- ▶ emergency organisation
- ▶ emergency facilities
- ▶ emergency plans
- ▶ team preparedness and
- ▶ qualitative assessment of performance in exercises
- ▶ quantitative assessment of performance in exercises
- ▶ The aggregate score is termed emergency management capability.
- ▶ The key features of the empire approach to assessing emergency preparedness are:
- ▶ that it allows the assessment of emergency arrangements against the perspective of the site risks;
- ▶ it enables any one site to benchmark its performance against other major hazard sites; and
- ▶ it offers a powerful diagnosis tool for where best to target resources for maximum improvement in emergency response capability.

### Derivation of the **empire** model

The structure of the empire model was based on the COMAH regulations and a list of established good practice, contributed by OCTO. Each indicator was scored in detail, against parameters such as availability, effectiveness, alignment with strategy, and company in-house capability. Contributions were then invited from industry collaborators to check for missing or superfluous elements and the model was refined several times to reflect industry requirements. Finally, all the individual scores were ratified by the company concerned.

The final structure is shown schematically in Figures 1 and 2.

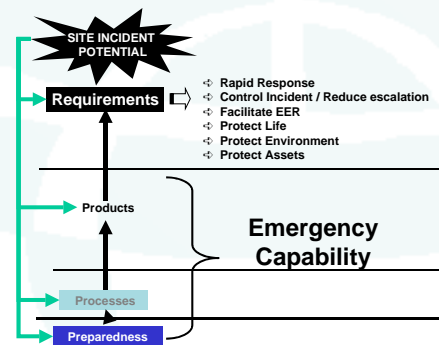


Figure 1 - Overview structure.

The Site Incident Potential (SIP) is a measure of difficulty for emergency management on site. It comprises an aggregation of the following elements:

- ▶ inventory in major hazard scenarios
- ▶ complexity of technology
- ▶ site population density
- ▶ diversity of hazards
- ▶ speed of scenario development
- ▶ level of off-site risk
- ▶ The SIP scale is calibrated so as to compare directly with the emergency capability of the site.
- ▶ The emergency management capability perspectives are illustrated in Figure 2.

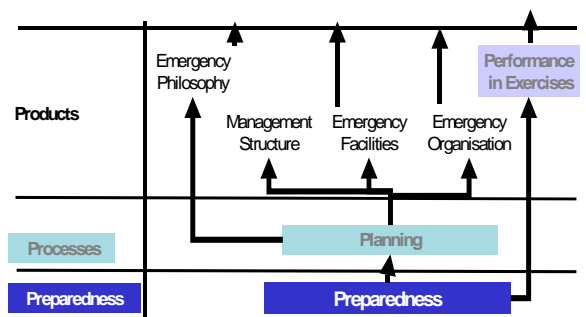


Figure 2.

At each stage these are assessed in the context of the strategic requirements of the site emergency arrangements, namely:

- ▶ initiate rapid response
- ▶ control incident / reduce escalation
- ▶ facilitate evacuation escape & rescue (EER)
- ▶ protect life (beyond EER)
- ▶ protect environment
- ▶ protect assets

The links between Site Incident Potential, Strategic Requirements and Emergency Management Capability are achieved through a series of relationship matrices, rolled up through a balanced score-card. Each matrix is very simple, and easy to tune to site requirements if necessary. For most sites, the standard matrices served without modification. Sites with specific unusual factors, for instance particularly sensitive environmental risks, found that a minor adjustment better reflected its situation.

A crucial point in developing a complex management model is to ensure that the complexity of the model in its inherent assumptions and sensitivities does not affect the overall conclusions. The strength of the balanced score-card technique is that it smoothes any minor anomalies in the relationship factors but retains in the final analysis the effect of those which are material.

Extensive sensitivity studies were undertaken to test and indeed prove the integrity of the empire model.

We were able therefore to present a validated model that assesses:

- ▶ site risks and how they determine emergency requirements (Site Incident Potential or SIP);
- ▶ how capable is the organisation in satisfying their emergency requirements.

### The **empire** benchmark report

An individual company can see its performance in true perspective. The first presentation is an

overall comparison of emergency capability with site requirements. Figure 3.

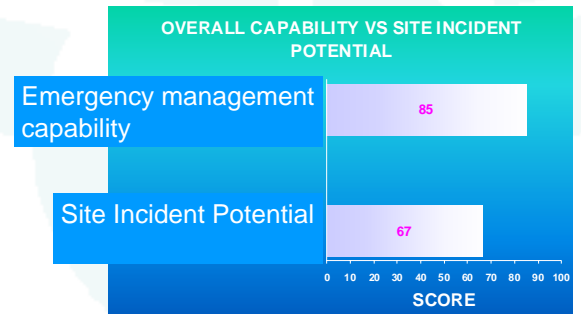


Figure 3. This overview is indicative but coarse. A more detailed breakdown is provided in Figures 4 to 7. Figure 4

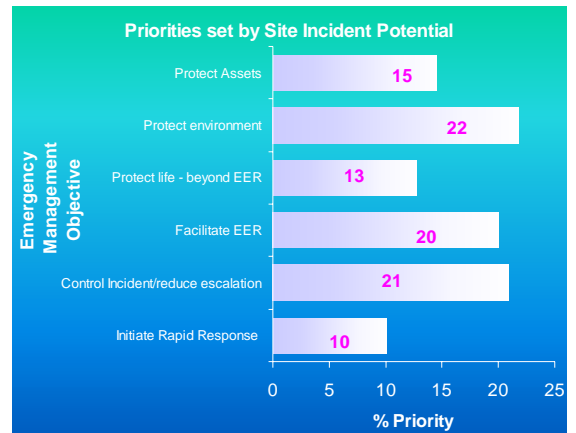
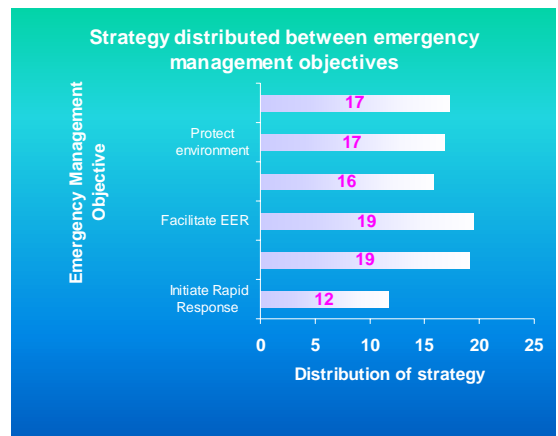


Figure 4 shows where the emphasis needs to apply in site emergency arrangements – as set by the Site Incident Potential.

This can then be compared with the actual emergency preparedness priorities, and any discrepancies analysed. Figure 5.

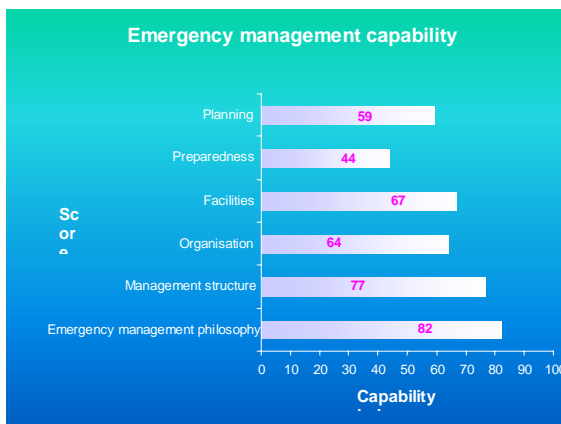


Here we can see a reasonably good match, with perhaps a shortfall in the ability to protect the environment during an incident.

Next we can analyse emergency capability in more detail. Figure 6.

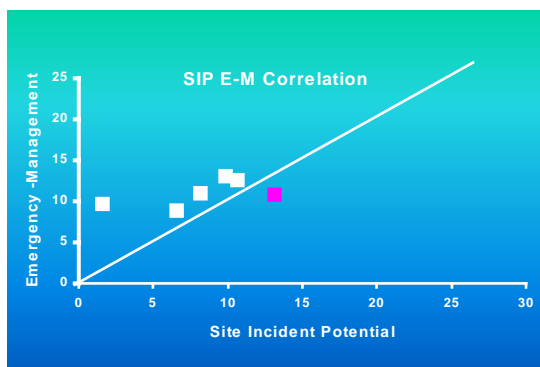
Figure 6.

The balanced score card gives us the ability to



compare each emergency capability perspective against the SIP. Figure 7.

Figure 7.



Those points which fall below the line indicate where improvements are required in the site emergency arrangements.

For each perspective of emergency management capability, the empire model can produce a detailed benchmark. Figures 8 and 9.

Philosophy Score Breakdown

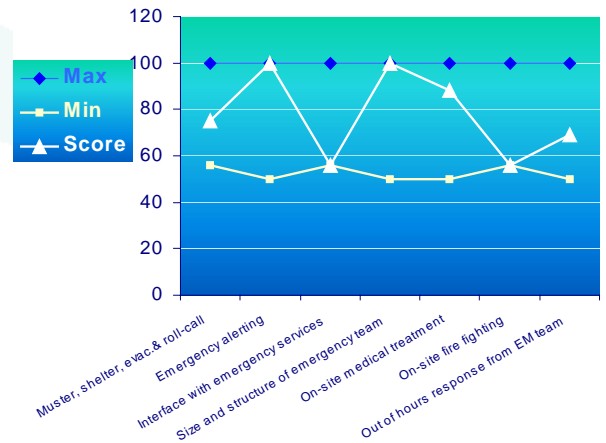


Figure 8.

Figure 8 shows how the company compares against its peer group in one of the six perspectives. Similar figures are available for the remaining five.

Emergency Management Philosophy

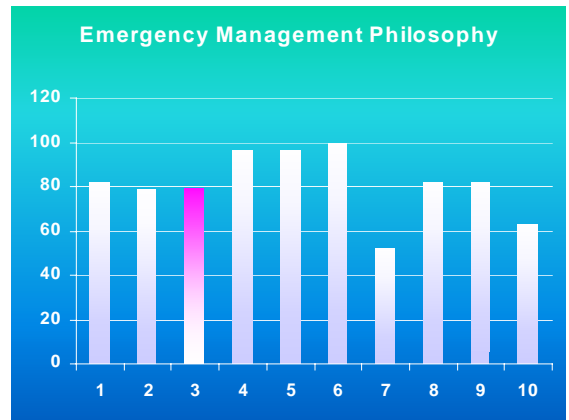


Figure 9.

Figure 9 shows how the company compares against best and worst in peer group for each of the elements that make up the perspective. For emergency philosophy, the elements are illustrated in the diagram above.

The detailed assessment of management structure, organisation, facilities, emergency plans and team preparedness included such topics as:

emergency procedures; mandates for decision-making; layout of emergency control centre; communications and information management; team structure; selection of personnel for emergency duties; training; competence; essential knowledge; refresher training; testing of emergency plans.

A detailed benchmark is offered for each of 61 parameters.

### Emergency Exercises

As the closest available analogue of reality, a part of the project was to observe how well each company performed in a demonstration exercise. The focus in exercise assessment was both the effectiveness of emergency management and the effectiveness of exercise response in saving life and otherwise mitigating consequences of the incident.

Those elements of emergency exercise performance examined at the exercise were:

- ▶ evidence of senior management commitment;
- ▶ discharge of mandates;
- ▶ qualities of emergency controller and deputy;
- ▶ information management;
- ▶ team performance;
- ▶ adequacy and use of resources;
- ▶ adequacy and use of facilities; and
- ▶ performance outside procedural envelope

A key determinant of performance was the success of the team in achieving sufficient response in a certain time, as illustrated by the Task Performance Resource Constraint (TPRC) model in Figure.10.

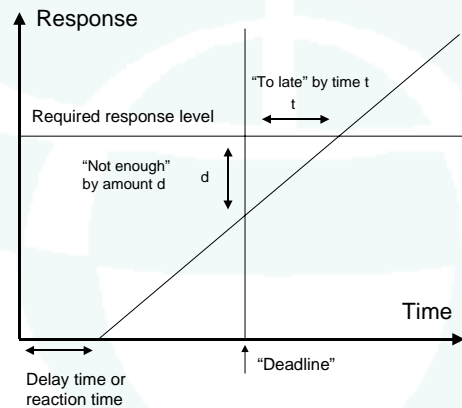


Figure 10.

The TPRC model from Cranfield University was piloted to good effect in this project. The model is itself a subject for a separate paper. Here we show in Figure 11 the results of applying the model to the analysis of a scenario.

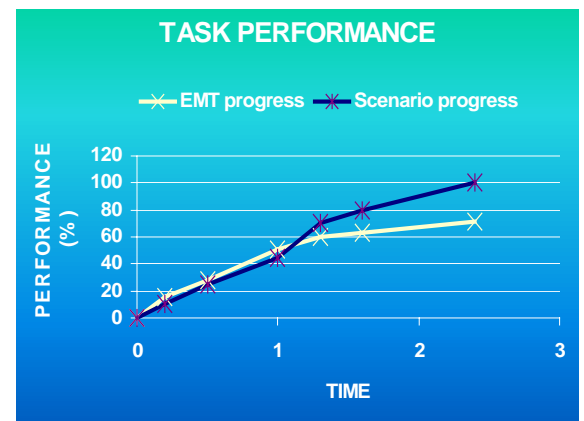


Figure 11.

The dark line shows the progression of the scenario and the light line the actions of the emergency team. It can be seen that in the initial stages, the team were on top of the emergency, responding appropriately and in good time. Later on, the team fell behind as the emergency escalated. The critical end result here was that the team failed to rescue a casualty before unacceptable injuries were sustained.

## A case study in diagnosing how to best improve emergency effectiveness

For instance, take the company whose capability profiles are shown in figures 4 and 5. Figure 4 shows that that maximum effort that needs to go into protecting the environment. Figure 5 tells us that although priorities are reasonably well aligned, there is a shortfall in effort on the environment, and indeed this is shown up as the red dot in Figure 6. In all other areas, the effectiveness of emergency arrangements would appear to be broadly adequate. Figure 3 completes a consistent picture.

So what should this company do for the best to improve its environmental emergency performance? Analysing the balanced score card we see that the main weakness in emergency philosophy derives on the one hand from a mismatch in resources within the on-site response team to undertake simple fire-fighter responses eg. fire-fighting, gas cloud dispersion and blocking or clearing spills / diverting drains. This is coupled with an over-reliance on the external fire-services who are unlikely to respond early enough to effectively mitigate the environmental hazard.

The score (Figure 6) in emergency planning and testing is also low. This derives from a weak emergency exercise regime, which is not targeted adequately to the environmental hazard.

Training and exercising a few extra plant maintenance team members in environmental corrective action would improve both scores and improve emergency capability overall - but would this be sufficient? If we now input these changes into the empire model we can see our overall capability in environmental performance improve a little (From 17 to 19 in Figure 5) – but Figure 7 still shows a shortfall; some other factor that we have not yet addressed clearly has an influence.

Further perusal of our performance from Figure 6 shows us a low team preparedness score. Our model has recognised that in order to make an effective environmental response, the plant response teams will need resources and direction which in turn requires the active management from the site emergency management team. Their training regime gives only a very low level of confidence that they will be able to respond

effectively to a major incident - their essential knowledge of site and plant being the main weakness, coupled with an uncertain grip of emergency management techniques.

Finally, we see that there are some shortcomings in facilities and organisation. Detailed examination shows that these lie mainly in the areas of information management. The site control room needs some minor adjustments to introduce a couple of extra white-boards to improve the information management system.

We again adjust the model – we have changed 6 out of 61 variables from a score of 2/4(inadequate) to a score of 3/4(adequate). Our capability now shows no shortfalls and our improvement plan reads as follows:

- ▶ Train and exercise two extra maintenance team members per shift in response to environmental incidents – integrate into existing exercise plan.
- ▶ Improve the site knowledge of the emergency management team – especially in environmental response and site geography and give them some training in emergency management and information management techniques.
- ▶ Improve the information management facilities in the site emergency control room.

It would be wrong to become carried away with the numerical element of the empire model. The actual value of the numbers is of much less relevance than their relative values. It acts as a guide and a framework for analysing the strengths and weaknesses of emergency arrangements relative to site risks and for helping to target scarce resources to gain maximum added value.

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