Closure by R. G. Bea,[6] S. T. Hong,[7] and James S. Mitchell,[8] Members, ASCE

The writers would like to thank Larrabee and Augestad for their insights, valuable comments, and questions.

The decision analysis method has been successfully used in a wide vaiety of onshore and offshore problems. Examples of onshore applications include evaluations of inspection and repair issues for existing dams (24,32,34), assessment of alternative sites for nuclear power plants (29), evaluation of alternative transmission line corridors (36), assessment of alternative sites for an airport in Mexico City (27), and evaluation of alternative sites for an oil terminal and service base in Kodiak, Alaska (35).

The latter example is of particular interest because of the diversity of the groups contributing to the decision. These included petroleum companies, the Kodiak Island Borough, the Kodiak Native Association, and the United Fisherman's Marketing Association (31).

Unfortunately, at this time there is not a wealth of published references for similarly successful applications to offshore problems. The applications known to the writers are documented in confidential reports to offshore operating companies. Examples include decisions for siting a mobile drilling unit in Lower Cook Inlet, Alaska; evaluating alternative development systems for the Hibernia field (Canadian East Coast); assessing alternative ice loading and structural foundation resistance criteria for Beaufort Sea exploration and production structures; evaluating alternative exploratory drilling structures for use in the Beaufort Sea; and assessing alternative sites for platforms and subsea completions in the Santa Barbara Channel and offshore Spain. As these projects are carried to completion, hopefully, the information and experience can be released to the ocean engineering community.

In the authors' experience, the difficulties associated with assigning values of the utility function are directly proportional to the level of experience available for the problem at hand, the potential ranges and impacts of consequences, the number of key decision makers, and the motivations and backgrounds of those decision makers. The more relevant experience that can be brought to bear, the smaller the range and impacts of potential consequences, the fewer the number of key decision makers, the more positive their motives in reaching the best possible decisions with the resources at hand, and the more directly applicable their backgrounds to the problem at hand, the more likely that realistic utility functions can be developed with relatively few difficulties.

Augestad's point regarding the time value of different consequences is well taken. Many published studies consider the time effects associated with expenditures, inflation, and return on investment (e.g., 3). Some studies (e.g., 23) indicate how other types or categories of impacts

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over time can be considered by establishing a preference structure that is based on different time streams of consequences. The suggestion that all consequences, such as ecological and life impacts, should be discounted using an effective rate of interest would not seem to be tractable.

If the particular time stream of costs and incomes associated with a particular venture or alternative can be projected, then this stream should be used in preference to other more general assumptions. This has been done in the majority of studies cited in this discussion. In addition, the probabilities associated with the particular time stream, the costs, and the incomes can be included (21,22).

If the problem to be addressed and the group of decision makers are conducive to collapsing all potential consequences to one utility unit, money, then by all means it should be done. However, in the writers' experience, this has not been possible when the interests, backgrounds, and motivations of the decision makers differ greatly. This is particularly true when public decision problems are involved.

The assumption that the collapse or damage of the platform has the same probability in any one year is a major simplification. Correlations, proof testing loadings, inspections, replacements, repairs and potential degradation of platform capacity due to fatigue effects, corrosion and other factors have been omitted for the purposes of the illustrative example included in this paper. These factors must be included as appropriate to a particular problem, and few generalizations are possible.

Relative to fatigue effects, the writers are unaware of any tractable method for assessing the effects of fatigue damage on the failure or ultimate strength of a complex offshore platform system (overload triggered collapse of a fatigue weakened system). Fracture mechanics-based methods and system analysis methods are under development, which should alleviate this problem.

Relative to the effects of repairs in increasing the reliability of an offshore platform, the writers can cite many cases where the repairs or repair operations have resulted in a substantial degradation of capacity, or a decrease in the system reliability. The writers would suggest that the effectiveness of repairs should be viewed in a probabilistic framework. Many of these repairs fall far short of being completely effective and the repair operations can themselves lead to additional damage.

At this stage in our technology, the writers would be concerned with the application of Monte Carlo methods in evaluating the consequences associated with stochastic repair or renewal processes. This is because of the tendencies in many similar previous attempts to improperly describe the controlling physics and mechanics processes, avoid or ignore the correlation and dependency effects, and the numerical limitations associated with treatment of complex platform systems composed of many hundreds or thousands of elements. System reliability techniques are in their infancy as they can be realistically applied to complex offshore platform elements, materials, and loadings (25,26,28,33). Again, this is an area of important research and development for offshore platforms.

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