

ORGANIZATIONAL DESIGN AND ADAPTATION IN RESPONSE TO CRISES: THEORY AND PRACTICE

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INTRODUCTION

Organizational scholars have typically focused on events that are stable, routine, and predictable for theory development. This leaves the question of whether theories of organizations can be applicable to non-conventional events or crisis situations largely assumed and certainly not fully explored. Organizations sometimes do face major technologically based crises that can be highly costly. Crises faced by organizations often have their roots in both the external environment faced by the organization and in malfunctions within the organization (Perrow, 1984). While much of the previous research on organizational crisis has focused on avoidance, recent work on adaptive organizations suggests that design and expertise can work synergistically to effect performance, particularly in non-routine settings (Levinthal & Warglien, 1999).

In this paper, we ask, given that a crisis has occurred, what organizational design fares best and whether the organization should change its design when a crisis occurs. We do so by building a computational model to examine 69 real crisis cases from a neo-information processing perspective (Carley & Gasser, 1999).

THEORETICAL BACKGROUND

That organizational performance is affected by design is highly documented (Baligh, Burton, & Obel, 1990; Scott, 1987). However, the relationship between performance during a crisis and design has received less attention. A crisis is a critical situation that can have severe negative consequences to the organization if not handled properly (Carley & Lin, 1995; Perrow, 1984). Studies have shown that crises can degrade organizational performance and that organizational design can be an important factor in mitigating the impact of the crisis (Carley & Harrald, 1997; Perrow 1984). However, there are few studies that compare organizational designs with an eye to performance across a wide number of crises and none that compares actual organizational behavior with a formal model.

In this paper, we intend to extend the literature of organizational design by developing a neo-information processing perspective (Carley & Gasser, 1999). We draw on work in contingency theory, information processing, cognitive science, and computer science. We characterize organizations as consisting of cognitively restricted, socially situated, and task oriented actors (Carley & Prietula, 1994). We are interested in explaining organizational performance. It is generally recognized that information processing and its relation to decision making are the

essence of all organizational activities (Scott, 1987). It follows that the accuracy of decisions is a general indicator of organizational performance. Factors that influence accuracy, in this sense, influence performance under normal operating conditions and under stress, i.e., during periods of crisis. Organizational decisions result from the collective and integrative actions of all the actors as work, gather information, learn, communicate and make individual decisions in an interaction-knowledge space. A wide variety of previous research has indicated that organizational performance is affected by a myriad of factors including, though probably not limited to: the training of the individuals in the organization, the lines of communication and command connecting these individuals (organizational authority structure and the degree of centralization), the resources and information to which the individuals have access, the nature of the task faced by these individuals, and the type and severity of stress under which these individuals operate.

ARCHIVAL DATA

Using archival sources including journal articles, books, and news media, information was collected on the organizational design characteristics, stress, and performance of 69 organizations faced with technological disasters. These technological disasters create crisis situations to which the organizations must respond rapidly and accurately to mitigate adverse consequences. The organizations are drawn from 14 different industries. In each case, the organization was faced with a crisis, which had the potential to severely impact either human lives, the environment, or the local economy. We limit our attention to the period immediately surrounding the crisis.

For each case we coded 31 variables related to task environment, organizational design, stress, and performance. A code book, describing each variable and how to code each variable was constructed. The coding was also validated through independent checking.

The nature of the task environment was coded based on whether the components of the task faced by the organization can be processed independently (*decomposability*); and whether the distribution of tasks of different nature are clustered or dispersed (*concentration*).

Aspects of organizational design were coded according to whether the organization's *authority structure* is based on hierarchy or team, whether *the resource access structure* is segregated or non-segregated, and whether the *training* is primarily operational or experiential.

Causes of crises, or stress, were coded based on whether the sub-optimal operating condition was related to *information uncertainty* or *agent malfunction*. *Information uncertainty* occurs when one or more pieces of information needed to make operational decisions are incomplete or incorrect. *Agent malfunction* occurs when one or more members of the organization are not at their post, are unable to communicate, or are replaced by new personnel when they are needed to make decisions that related to the organizational operations.

Organizational performance is coded for both the general situation and the crisis situation. For *performance in the general situation*, the frequency of prior similar crises, and the reputation of the organization in the local society were considered. For *performance during crisis*, both the

actual and potential severity of the crisis were considered based on the nature of the crisis, the industry standard, and the actual impact of the crisis.

CORP: THE SIMULATION MODEL

This conceptual model is embodied in the simulation framework that we refer to as CORP (Computational ORganizational Performance framework) (Carley & Lin, 1995, 1997; Lin, 2000). In this paper, we present a simplified description of CORP concentrating on those aspects that are relevant to this analysis. The CORP framework is a meso level multi-agent ACTS model (Carley & Prietula, 1994) in which each individual member of the organization is modeled as a cognitively restricted, socially situated, task oriented actor. The organization is modeled as in a distributed setting in which organizational decisions result from the collective and integrative actions of all the individuals in a holistic rather than simple additive fashion. Each organization is characterized by the lines of communication (organizational structure), who has access to what resources or information (resource access structure), and the training its personnel receive. Each organization operates in a particular task environment. Each organization operates under stresses such as sub-optimal operating conditions. Within CORP each of these items is a variable that can take on several different values.

The computational modeling of task environment, organizational design, and stress follows the similar line as described in the archival data. Within CORP, however, organizational performance is measured in terms of average accuracy on a categorization/choice decision task. For the in general condition, we measure performance across all 19,683 possible events with nine attributes and three values under all levels of sub-optimality (none, one, two, or three). For the during crisis condition we measure performance across just those events defined to be hostile and where there are one or more sub-optimality. The percentage is then transformed into the similar level of performance (low, medium, or high) as coded for the archival data.

COMPARISON PROCESS FOR MATCHED ANALYSIS

We compare our theoretical model (embodied as a computational model) with "reality". The computational model serves as an encapsulation of organization theory and generates a series of predictions regarding how to design an organization that is faced with crisis so that it is effective. The "reality" is a set of data concerning the relative effectiveness of 69 actual organizations faced with actual crises.

Given the 69 real cases we generate a matching set of 69 artificial organizations. We compare the relative performance of the real organizations and their artificial counterpart under both general and crisis conditions. This comparison provides a partial test of the model. Many of the real organizations restructure their design when faced with a crisis. We can use the model to ask the question, would the performance of these organizations have been higher or lower if they had not been restructured. In this way, we can begin to assess the relative value of restructuring organizational design in response to crisis.

We find general agreement between model and reality. The Spearman correlation between the artificial and real organizations for general performance is 0.705 ($p < 0.000$). This correlation

drops to 0.553 ($p < 0.000$) for performance during crisis. This suggests that the relative impact of different organizational designs and stress is similar in the simulation framework and the real world. We now turn to a more detailed analysis.

Designing for High performance

We begin by asking whether the organizational design that exhibits highest performance during a crisis is also optimal under non-crisis conditions. We find that the optimal design for crisis may not be the optimal design in general.

We further find that training, unlike the other elements of design, does have a consistent effect on performance. Specifically, experientially trained organizations will outperform operationally trained organizations both in general and during a crisis. This seems to be true in both the simulation and the real world.

Another prediction derived from CORP is that for experientially trained organizations as more things go wrong (more sub-optimalities) organizational performance degrades. In the real world we observe that sub-optimalities similarly degrade performance for experientially trained organizations. However, we see a different pattern for operationally trained organizations in both the framework and the real world. In our 69 cases we do not observe this "U" shaped relationship between sub-optimalities and performance. This result should be viewed with caution as we have only two cases with three or more sub-optimalities.

In the artificial organizations we observe that the impact of the sub-optimality on organizational performance depends on what it was that went wrong. Basically, if the error is attributable to agents, organizational performance is lower than if it is attributable to the quality of the incoming information. This is true whether the organizational members are trained to follow experience or standard operating procedures. We see this same pattern in the real data too.

Dynamic Adaptation

Finally, let us consider the role of organizational restructuring. We find, among the 69 real organizations that 38 out of 69 organizations altered either their organizational authority structure or their resource access structures or both when confronted with a crisis. These organizations switched their designs toward more complex designs. The number of restructurings in resource access structure is eight times as large as the number of restructurings in organizational authority structure. This suggests that organizations are more likely to maintain existent lines of communication and authority during crises but are more likely to restructure who has access to what and responsibility for what. Of all the 69 organizations, only 31 did not alter either their organizational authority or resource access structures.

This data show that organizations faced with crises do increase their structural redundancy and move to more flexibility in accessing information and resources. However, it does not tell us whether this increase in redundancy has value. To answer this question we turn to a form of "what if" analysis. Using the framework we examine the performance of these organizations

under the condition that they did, and that they did not alter their design. Thus we can ask the hypothetical question: what if the organizations had not altered their design?

The framework suggests that whether or not the organization should alter its design, given that a crisis has occurred, depends on whether the personnel are trained experientially or operationally. For experiential organizations, performance improves when crises occur whether or not the organization alters its design. For operational organizations performance degrades when crises occur whether or not the design is altered. As predicted by our model we observe performance improvements during crisis for experientially trained organizations and performance degradations for operationally trained organizations whether or not they restructured. Clearly, some organizational restructurings lead to higher performance (or less degradation) than do non-restructurings.

Using simulation we can move a step beyond this finding. The CORP simulation model predicts that for the experiential organization, the organization will see less of an improvement in performance due to crisis if it alters design. Thus, experiential organizations that actually do restructure theirs when faced with a crisis may mistakenly attribute the improvement in performance to the restructuring. In this case, experiential organizations that alter designs when faced with crises may mistakenly attribute the improvement in performance to the fact that they altered their design. When in fact, these same organizations might have experienced even greater gains in performance had they not restructured. In contrast, for the operational organization performance degrades when crises occur whether or not the organization alters its design. Further, for the operational organization, the organization will see less degradation in performance due to crisis if it does restructure. In this case, operational organizations who alter designs when faced with crisis may mistakenly interpret their degradation in performance as attributable, at least in part, to having altered their design. When in fact, these same organizations might have experienced even more performance degradation had they not restructured. Clearly these “what if” predictions cannot be tested with the particular real data we have used in this paper. However, the general fit between model and data suggests the plausibility of this analysis. Future work, perhaps in an experimental setting, might look at this issue in more detail.

CONCLUSION

This study has examined the relationship between strategic design and performance for organizations under normal and crisis operating conditions. We took the stand that crises are essentially inevitable and asked how should organizations be designed to mitigate the effect of the crisis. We also examined whether the organization should alter its design when faced with a crisis. Our results indicate that, both in theory and in practice, performance is so conditional that the same design is rarely best for both non-crisis and crisis conditions. Further, organizations, depending on the training and decision making procedure, can benefit from restructuring when faced with crises. However, organizations may misinterpret the effect of altering their design. This study has strong implications for strategic management as it has demonstrated the impact of organizational design for strategic decision making but also specified the boundary conditions for critical environmental conditions.

There are limitations to this study in the computational framework, the data on the corporate world, and the overall experimental design. Despite these limitations, we believe this study has its significant contributions. First of all, this study examines both artificial and real organizations. Second, this study has viewed a crisis event as fundamentally an organizational issue and effectively demonstrated the benefit of adopting an organizational design approach to crisis management. Third, this study has implications beyond the field of crisis management. Fourth, this study has shown the effectiveness of computational modeling.

We hope the approach used in this study and the results from this study can provide new directions for future research, both empirically, methodologically and theoretically, which can significantly expand our thinking and advance the field of organization science.

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