# Combinatorial Nature of Final Strategic Choice

John N. Warfield
January, 2009

## Abstract

A natural question to be posed pertains to the combinatorial nature of the conditions facing high-level managers when they make what amounts to a final strategic choice in a problematic situation. Such a choice involves unusual resource commitment, possibly risking the future of the organization. Combinatorial nature refers both to the magnitude of the strategy universe and to the sensitivity of the outcome to a particular choice that is made.

Final strategic choice may be based on a structural model, applying measures of complexity and insights derived from applying the Work Program of Complexity to develop the problematique for the situation facing the high-level manager. Two specific cases are used to illustrate the combinatorial nature of final strategic choice. A Waste Rebate accrues to the benefit of the manager whose choice is highly conserving of resources.

## Introduction

Certain problematic situations score sufficiently high on defined indexes of complexity that they require novel means of assisting high-level managers to make those final strategic choices that commit major organizational resources.

These situations defy classification by conventional academic disciplines and are identified by assessing the state of understanding of people concerning the situations. Once it is determined that no one understands the situation, but a representative group of people can be brought together to collaborate in carrying out the Work Program of Complexity, it becomes possible to assess the combinatorial aspects of the strategic possibilities.

The minimum essential product of group activity with which to assess the combinatorial aspects is called a “problematique”. Many of these have been developed over the past three decades. A small, but representative number of them are available in the open literature and, more specifically, in books. Twenty-two of them are identified in Table 1 along with the names of individuals who were associated with their development, and the names of books in which they appear. By scanning the titles of the problematiques, an idea of the wide variety of situations involved can be gained, illustrating the point made earlier that the situations defy classification by conventional academic disciplines, and are identified by assessing the state of understanding of people concerning the situations.

## The Problematique

The problematique is an oriented structural graphic. Once constructed, and once mastered as a form of communication, it conveys to the reader how component problems in a situation affect one another for the worse. The orientation is conveyed by arrows on the diagram that connect problems to one another. If an arrow points from a first problem to a second, it means that the first problem makes the second one worse.

The entire structure being oriented, one can speak of the flow of aggregation. With the insight gained from learning to read a problematique, one can see which problems are more basic than other problems. This kind of information is critical to final strategic choice.

Table 1 mentions problematiques of Types 1 and 2. The Type 1 problematique is the one just described. The Type 2 problematique condenses the Type 1 by replacing problems with categories of problems; i.e., all problems that fall in a certain category are aggregated. This yields a second and more aggregated version that offers still more insights into how to carry out a strategy that may be chosen, since categories can be related to organizational structures more readily than can individual problems.

## Pump Manufacturing, Type 1

One of the problematiques mentioned in Table 1 is that involving pump manufacture. This one is chosen as a first illustration of the foregoing general remarks because it much less

abstract than many other examples, and is easier to be visualized. Still it is representative of what will be encountered in other situations. Moreover it has the advantage that it was carried through from beginning to a satisfactory ending–something that is not always recorded or not always known.

The story of this situation has been published in detail (Warfield, 1990, 1994). The details were furnished by Dr. Robert James Waller (famous as the author of popular novels). The outlines that are relevant to this paper are summarized here. A large midwestern manufacturer was having troubles in manufacturing large, expensive pumps. More than half of these pumps were being rejected at the end of the production line. A variety of remedies were sought to no avail. Eventually Dr. Waller proposed developing the problematique. When this was done, the insights gained were sufficient to resolve the situation. What follows will illustrate the development of strategy for doing so.

**Identifying and Clarifying the Component Problems.** Instead of assuming, as is often done, that there is just one problem involved, the representatives of the company were asked to identify and clarify possible component problems in the situation. When they did so, they uncovered the possibility that there were as many as *26 problems* that could be involved in causing pump rejection. It is this possibility of multiple causality that introduces the combinatorial aspects of the situation, when development of a strategy is at stake.

*Combinatorial Thinking.* Combinatorial thinking has to do with counting. One may begin by asking "how many different strategies may be involved in this situation?". Suppose the first possibility thought of is to test this commonly-held strategy:

**Single-cause Strategy.** If one assumes that there is a single cause, it could be any one of the 26 problems. Now imagine that each cause is tested separately. This could involve running the production line while "tweaking" a single cause in hopes that somehow this would reveal that the single cause was the source of the difficulty. This could involve as many as *26 strategic possibilities***.** The cost and complexity involved in such testing.are likely to introduce new difficulties that would obscure a resolution, even if could be a consequence of a single cause. This possibility had actually been tried and had not been successful, which is why Dr. Waller's suggestion was adopted.

**Two-cause Strategies.** Suppose somehow one imagined that two of the 26 problems were acting together to corrupt the production process. There is a formula for determining how many pairs of problems would be possibilities. This formula is known as the formula for the number of combinations of N things taken k at a time. Applied with N = 26 and k =2 gives *325 strategic possibilities.* The possibilities for diagnostic difficulties, even with only two causes acting in concert, are horrendous to imagine, and may implicitly encourage managers to stay with an inappropriate single-cause assumption.

**Three-cause Strategies.** Continuing, how many strategic possibilities would there be if three problems, acting together, were the origin of the pump production problem? The answer is *2600 strategic possibilities.*

As one can readily see, even with only 26 component problems, the combinatorial aspects of this situation pose tremendous difficulties. It is totally impractical to test all of the combinatorial possibilities. What should be done? Should a great manager be sought, whose insight would reveal the best choice? Or should some numerical method be sought that would reveal what to do? Or could not the insights revealed by examining the logic of the interrelationships as shown in the problematique provide the best way of getting at the result?

**Structuring an Influence Relationship Among the Component Problems.** Since Dr. Robert James Waller was already familiar with computer software that would support the group development of the problematique, he provided leadership for a group of engineers to develop the problematique using a part of the Work Program of Complexity called Interpretive Structural Modeling (ISM). The problematique that was developed appears in two books, as indicated in Table 1. It will be discussed in detail in what follows.

**Insights from the Problematique.** As explained in the books, with reference to the problematique, four of the problems were seen as key in aggravating other problems, and one additional problem was seen as part of a cyclic pattern of aggravation. This produced one group of five problems, obtained by a combination of visual inspection of the problematique and insight of the engineers who had carried out a portion of The Work Program of Complexity, involved in developing the problematique.

It is worth while to keep in mind that this one group of five problems is *one out of 65,780* possibilities involving 5 problems from a set of 26.

**Results.** *When this group of 5 problems was attacked as an aggregate, the production problems were resolved immediately. The conclusion: A final strategic choice was made as a consequence of pursuing the following sequence of events:*

- *applying the Work Program of Complexity to produce a problematique*
- *inspecting the problematique to gain the insights required to make the final strategic choice, which was appropriate to resolve the problematic situation that had not yielded to any other strategy.*

## Investment Decision, Type 1

The second case to be considered briefly involves a multi-billion dollar investment decision. For competitive reasons, the specific final strategic choice cannot be stated here, but the essentials of the choice can be given. A high-level executive in a Fortune 100 company approached a very senior researcher who was known to be expert in application of the Work Program of Complexity. The researcher was asked to provide, in less than a week, a studied response to the question of whether the company should choose a strategy of striving to become the world leader in a speculative, but potentially very lucrative business area.

# LIST OF PUBLISHED PROBLEMATIQUES: Prepared January 26, 2007

C:\Documents and Settings\Owner\My Documents\My Papers\COMBINAT NATURE-STRATEGIC CHOICE\STRATEGICCHOICE-COMBIN NATURE\COMBINATORIAL NATURE.wpd

| Source of Problematique | Title of Problematique | Where is it published? |
|---|---|---|
| John N Warfield | Policy Research, Type 1 | UCT&B, page 204 |
| John N Warfield | Policy Research, Type 2 | UCT&B, page 213 |
| Scott M. Staley | Analytical Power Train, Type 1 | HIM, page 305 and 306 and UCT&B, page 215 |
| John N. Warfield | Analytical Power Train, Type 2 | UCT&B, page 216 |
| Benjamin Broome and the Staff, Joint Chiefs | Joint Operations, Type 1 | UCT&B, page 218 |
| John N. Warfield | Joint Operations, Type 2 | UCT&B, page 219 |
| Benjamin Broome | Problem-Solving Groups, Type 1 | UCT&B, page 224 |
| John N. Warfield | Problem-Solving Groups, Type 2 | UCT&B, page 225 |
| Benjamin Broome | Peace-Building in Cyprus, Type 1 | UCT&B, page 226 |
| A. Roxana Cárdenas and Carmen Moreno | Industrial Development in Nuevo Leon, Type 1 | UCT&B, page 227 |
| Carol Jeffrey | Gender Issues in Liberia, Type 2 | UCT&B, page 228 |
| Carol Jeffrey | Disarmament and Demobilization in Liberia, Type 2 | UCT&B, page 229 |
| Robert James Waller | Pump Manufacturing, Type 1 | ASOGD, page 395 and UCT&B, page 230 |
| Roy Smith | The Redemptorists–Church in England, Type 1 | UCT&B, page 231 |
| Roy Smith | Computer Help Desk Redesign, Type 1 | UCT&B, page 232 |
| Scott M. Staley | Manual Transmission Gear Design, Type 1 | UCT&B, page 233 |
| Alexander Christakis and Henry C. Alberts | Smart Munitions, Type 1 | UCT&B, page 234 |
| John N. Warfield | Computer and Information Systems Industry, Type 1 | ASOGD, page 312 |
| Alexander Christakis and Harris Sokoloff | Shared Governance in School Districts in Pennsylvania, Type 1 | ASOGD, page 323 |
| Alexander Christakis and xxxxxxxxxxxx | National Marine Fisheries Service, Type 1 | ASOGD, page 359 |
| Alexander Christakis and Henry Alberts | Department of Defense Program Management, Type 1 | ASOGD, page 376 |
| Alexander Christakis and Wojceich Gasparski | Developing a Design Culture in Higher Education, Type 2 | ASOGD, page 521 |

HIM = Handbook of Interactive Management (1994) ASOGD = A Science of Generic Design (1994) UCT&B = Understanding Complexity: Thought and Behavior (2002)

The researcher gathered a small group of personnel who were well-informed in the physics, engineering, and economics of the area. Together they worked for three days in developing both Type 1 and Type 2 problematiques. After assessing the problematiques, the researcher was able to report to the high-level executive the likely business consequences and cost in billions of pursuing three strategies:

- **Strategy 1. Seeking to Gain World-Wide Market Dominance.** Applying enough resources to make the company dominant in the world-wide market.
- **Strategy 2. Adopting a Middle-level approach.** Applying enough resources to make the company competitive, but not a world leader
- **Strategy 3. Taking a Minimal Stance.** Allowing the company to sustain a position, but devote most resources to other areas

Because of the in-depth rationales and quantitative estimates that could be provided with the aid of the insights developed with the aid of the structural analyses, the high-level manager accepted and implemented the conclusions of the study.

As before, the number of problems involved was substantial, with a high combinatorial aspect. Nevertheless the structural nature of the problematique permitted insights to be generated which lent themselves to rapid distillation into the three strategies indicated.

## Some Structural Characteristics of Problematiques

Table 2 repeats that portion of Table 1 which involves the Type 1 problematiques, but this time offers data on some attributes of these structures for purposes of analysis. These data can be readily observed by inspecting the problematiques.

**Cycles.** The first column of data gives the number of cycles in the problematique. A cycle is a set of problems which mutually aggravate each other. As can be seen from Table 2, there are two problematiques that had no cycles, while two of them have as many as five cycles. The average for the 15 problematiques is 2.2 cycles.

**Problems.** The second column of data gives the number of problems in the problematique. These also can be easily counted. As can be seen from Table 2, the smallest number of problems for any of them was 10 and the largest was 33, while the average number is computed to be about 22. If a problem lies in a cycle, it means that it both aggravates (makes worse) other problems in the cycle and is, itself, made worse by the other problems in the cycle. A problem lying in a cycle is called a “cyclic problem”. If an entire cycle of problems is aggravated by at least one non-cyclic problem, it is called an “aggravated cycle”.

**Drivers.** Some problems are not aggravated by any other problems, but they aggravate other problems. Those problems are called drivers. Those problems lying in cycles that are not in aggravated cycles are also called drivers, provided the cycle itself aggravates problems that do not lie in the aggravated cycle. Generally speaking, the drivers are likely

# SOME PROPERTIES OF PUBLISHED TYPE 1 PROBLEMATIQUES

C:\Documents and Settings\Owner\My Documents\My Papers\COMBINAT NATURE-STRATEGIC CHOICE\STRATEGICCHOICE-COMBIN NATURE\COMBINATORIAL NATURE.wpd

| Title of Problematique | Where is it published? | Number of cycles | Number of problems | Number of drivers |
|---|---|---|---|---|
| Policy Research, Type 1 | UCT&B, page 204 | 1 | 16 | 4 |
| Analytical Power Train, Type 1 | HIM, page 305 and 306<br>UCT&B, page 215 | 2 | 26 | 3 |
| Joint Operations, Type 1 | UCT&B, page 218 | 3 | 23 | 7 |
| Problem-Solving Groups, Type 1 | UCT&B, page 224 | 1 | 23 | 9 |
| Peace-Building in Cyprus, Type 1 | UCT&B, page 226 | 2 | 22 | 4 |
| Industrial Development in Nuevo Leon, Type 1 | UCT&B, page 227 | 3 | 19 | 3 |
| Pump Manufacturing, Type 1 | ASOGD, page 395<br>UCT&B, page 230 | 2 | **26** | 8 |
| The Redemptorists–Church in England, Type 1 | UCT&B, page 231 | 3 | 26 | 3 |
| Computer Help Desk Redesign, Type 1 | UCT&B, page 232 | 0 | 17 | 6 |
| Manual Transmission Gear Design, Type 1 | UCT&B, page 233 | 3 | 24 | 6 |
| Smart Munitions, Type 1 | UCT&B, page 234 | 5 | 19 | 2 |
| Computer and Information Systems Industry | ASOGD, page 312 | 0 | 10 | 2 |
| Shared Governance in School Districts in Pennsylvania | ASOGD, page 323 | 0 | 20 | 2 |
| National Marine Fisheries Service | ASOGD, page 359 | 5 | 25 | 2 |
| Department of Defense Program Management | ASOGD, page 376 | 3 | 33 | **1** |

to be among the most troublesome problems, because they continue to aggravate other problems in the problematique, even though resources may be expended to try to resolve those other problems. Hence it is wise to look first toward the drivers, as was the case in the pump manufacturing problem. In that example, five problems were chosen to attack as a group, as part of the final strategic choice. Four of those problems were drivers, and the other one was a cyclic problem in an aggravated cycle. Based on calculations given earlier, the likelihood of making that particular choice at random was 1 in 65,780.

*The choice of strategy involves a combination of insights gained from observing the problematique, coupled with those insights coming from knowledge of the situation.*

As can be seen from Table 2, from the data on the fifteen problematiques represented there, there was one instance where there was a single driver, namely the problematique representing Department of Defense Program Management. (That case is so unusual that it merits discussion, as in the next section.) The maximum number of drivers is 9, this found in a graduate class in communication which studies problem-solving groups to see what difficulties are likely to be found in such groups. The average number of drivers is computed to be approximately 4.

**The Single-Driver Problematique.** The commonly-made assumption of the single cause, which has a long history associated with the philosophical concept of causality, would correlate with a problematique having a single driver. In hundreds of instances, a single driver in a Type 1 problematique has only been seen once, and that is why the occurrence shown in the last row in Table 2 is of interest. This problematique also has the largest number of problems, 33, of any of the problematiques. It is possible to discuss this without portraying the problematique itself, although the interested reader may return to the reference if desired.

The problem shown as the single driver is:

*Dilution of the program manager's authority*

According to program managers, this can occur for many reasons, but one reason is that orders come down from the chain of command from above the Department of Defense that are often motivated by political considerations, having to do, for example, with manufacturing in local political jurisdictions, that cause unanticipated budget dislocations, which wreak havoc with carefully laid out plans.

Aside from this, the problematique in question is very revealing when one looks at what the situation would look like if this particular problem were sliced from the problematique. If that were done, and everything else were unchanged, the number of drivers would increase dramatically from 1 to 13! This is mentioned only to emphasize that the apparent simplicity of having a single driver is highly misleading, since it masks the complexity occasioned by the next stage of aggravation stemming from the presence of what the problematique shows. The next stage actually involves one aggravation cycle with 9 members and another aggravation cycle with 3 members, as well as one more member which does not lie in a cycle. In other words the complexity is just displaced to the right, so to speak, in the problematique (when viewing it from left to right).

This problematique also contains another aggravation cycle with 15 members. It is highly unusual in its structure. Perhaps it is not too surprising that the problematique representing program management in the Department of Defense would be strikingly different from the other problematiques, and that it would reflect highly interactive structural tendencies typical of what would be expected from intensely political bureaucracies.

## The Waste Rebate

The concept of "rebate" has attained a unique position in market transactions in recent years. While probably not a market ploy favored by consumers, it appears to be one that is greatly favored by marketers. In review, this concept is normally presented as a reward to an individual for engaging in some market activity.

The idea of "waste rebate" is introduced here. It is intended to retain the concept of "reward", but to reward a high-level manager for making a final strategic choice that avoids substantial waste. Since there appears to be no known standard means of measuring waste, or little reference to waste in the management literature, in introducing it here it is appropriate to connect it to the discussion of the combinatorial nature of final strategic choice.

Strategic choices historically have been made without the benefit of the insights that are readily obtainable, as has been explained and illustrated, by development and examination of the problematique. While it may not always be possible to construct problematiques after the fact, so to speak, the well-known French historian, Michel Foucault, has proposed that the appropriate way to write history is to construct the problematique long after events have occurred. This suggests, and experience with the development of many problematiques, virtually guarantees that it will often be possible to construct problematiques months or years after final strategic choices have been made, *using information readily available at the time the choice was made.*

At the future time in which a problematique is constructed to represent a situation at some earlier time, it may be relatively easy to assess the costs or benefits by whatever measures is adopted (human lives, currency, or other combined measures) associated with the particular strategic choice that was made at the time. It may then be not as easy, but still feasible, to estimate the corresponding values associated with the particular final strategic choice that is indicated by inspection of the problematique. If it should be true, as one might suspect, that the added information obtainable by applying the insights available from the problematique would have produced greater benefits, it would then be possible to determine how much was wasted by not developing and using the problematique.

The difference between the two assessments could then be called the "Waste Rebate" that would have accrued if the high-level manager had been willing to take advantage of the problematique at the time.

Going a bit further, suppose the manager was willing to engage in a "game" in which the problematique was developed and a team proposed a final strategic choice C-1, while the high-level manager at the same time proposed a different final strategic choice C-2. It would then be conceivable to assess at that particular time the potential Waste Rebate to be gained from one choice or the other. Or it would be possible at some later date to make

that assessment in the light of whatever information would come to light in the intervening time.

Finally, even if no Waste Rebate computation attempt were made, at least the effort to compare two different ways to attaining the final strategic choice were made, it is beyond doubt that the learning that would occur would produce a better-informed and more articulate final strategic choice in a world where the combinatorial nature of strategic choice places a new level of complexity on the shoulders of high-level managers.

## References


Warfield, J. N. and Roxana Cárdenas, **A Handbook of Interactive Management**, Iowa State University Press, 1994 (draft version published locally in preliminary form for review in 1991 and 1992).

Warfield, J. N., **A Science of Generic Design: Managing Complexity Through Systems Design,** Salinas, CA: Intersystems, 1990 (two volume set); Second Edition published by Iowa State University Press, Ames, IA, 1994, 558 pages.

Warfield, John N. (2002), **Understanding Complexity: Thought and Behavior**, Palm Harbor, FL: AJAR Publishing Company.