The Impact of Early Warning on Institutional Responses to Complex Humanitarian Crises

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ABSTRACT

This paper considers the problems of institutional response to the early warning of complex humanitarian crises (CHCs). We start with a typology of six different modes of early warning failure: strategic deception, conventional concealment, institutional ignorance, reflexive response, exogenous shifts, and systemic complexity. We discuss the extent to which each of these can affect the early warning of CHCs. We then consider the problems of cognitive, bureaucratic, and political constraints to effective early warning. The paper concludes that the early warning of CHCs is likely to remain decentralized in academic, nongovernmental (NGO) and intergovernmental (IGO) projects, but that because of increases in the availability of information this decentralization does not necessarily preclude effective early warning, and may in fact enhance it. There is, however, a need to augment the credibility, visibility, and efficacy of these efforts, as is being done through efforts such as Forum for Early Warning and Emergency Response (FEWER) and ReliefWeb.

Introduction

In recent years, the topic of early warning—moribund for about a decade after substantial research in the late-1970s (see Hoople, Andriole and Freedy 1984; Singer and Wallace 1979; Choucri and Robinson 1979)—has received renewed attention (e.g., Davies and Gurr forthcoming, Gurr and Harff 1998; Rupesinghe and Kuroda 1992; Schmeidl and Adelman 1998). This increased interest is due to at least three factors.

First, following the end of the Cold War the international system appears to have become more vulnerable to sudden outbreaks of serious systematic violence, both international and inter-ethnic. Iraq's invasion of Kuwait, the conflict between Armenia and Azerbijan, the genocidal violence observed in Bosnia and Rwanda, and the violent internal conflicts in Somalia, Chechnya, Haiti, Algeria, and Liberia are all examples of this. The end of the Cold War "removed the lid" from long-simmering regional and ethnic disputes, most conspicuously in Armenia-Azerbijan and in the former Yugoslavia. The disappearance of communism as an ideological principle for organizing conflict appears to have stimulated lethal disputes organized along ethnic and religious lines, frequently augmented by economically-motivated gangsterism. Many of these combine the traditional problems of civil war with famine, refugee movements, large-scale violations of human rights, and a variety of levels of international intervention and thus have come to be labeled as "complex humanitarian crises" (CHCs).

With the end of the perceived threat of Communist exploitation of ethnic divisions, the liberal-democratic military powers—the United States, Britain, and France—are less inclined to intervene in local or regional disputes. The international community instead has increasingly turned to multilateral responses, including the recycling of Cold War organizations (NATO in the former Yugoslavia and the United Nations generally), *ad hoc* initiatives (Iraq-Kuwait, Rwanda, Bosnia), and the use of existing non-military organizations in a peace-keeping role (ECOWAS in Liberia). This reliance on multilateral responses—which cannot depend on the threat or deployment of prompt, overwhelming force used by the Cold War powers—in turn enhances the attractiveness of early warning in two ways. First, there is general agreement (Cahill 1996; Crocker and Hampson

1996; Lund 1996) that smaller amounts of force—and ideally no use of military force, relying only on diplomacy backed by the threat of force or other international sanctions—are required to contain a conflict in its early stages. Second, multilateral responses require substantially longer to orchestrate than the rapid responses of a superpower or Cold War alliance. This has lead to significant interest by international organizations in early warning (e.g. Boutros-Ghali 1992; Dedring 1994).

Finally, changes in communications and computer technology have dramatically changed the quantity and timeliness of the information available for use in early warning. Information relevant to political early warning is available from the commercial efforts of Reuters, *Agence France Press* (AFP) and other news agencies, and from the equally vast, if more specialized, networks of field workers from nongovernmental (NGO) and intergovernmental organizations (NGOs and IGOs). One recent estimate states that the amount of information available in electronic form has increased by a factor of 10^6—one million times—since 1981.[1] In addition, inexpensive desk-top computers now surpass in capacity most of the main-frame computers available to national intelligence agencies until the middle of the last decade. The Internet and the related text-based electronic communications of news organizations, IGOs and NGOs can be processed directly by these computers. Whether this massive quantity of information can be *effectively* processed is another issue—this is the crux of the early warning challenge—but a researcher working with public domain sources in the late 1990s has access to orders of magnitude more real-time information and data processing capability than he or she would have had available even a decade earlier.

The Problem of Prediction

This paper will focus primarily on the forecasting of major political change (including social and economic change that is not overtly political) that might elicit a response from the international

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[1] Robert Grossman, President of "Magnify," quoted in a story about "data mining" by National Public Radio reporter Ivan Amato on National Public Radio's *Morning Edition*, 10 September 1998.

community.[2] Such forecasting has a long history in political science, most commonly as a systematic rendition of the "case study" or "lessons of history" technique that has been used by decision-makers since time immemorial (see May 1973; Jervis 1976; Neustadt and May 1986; Vertzberger 1990; Khong 1992) . History is considered relevant to decision-makers because they assume that when a particular set of events and circumstances observed in the past is observed again, the resulting events from that prior case can also be expected to apply in the new case, all other things being equal.

This simple observation is both reinforced and attenuated by the fact that it is reflexive: the methods that decision-makers use to interpret the past have an impact on how they create the future. If decision-makers act consistently on the "lessons of history," then history will in fact have lessons. In addition, situations of international conflict usually involve bureaucratic rather than individual behavior and, for a variety of reasons both theoretical and practical, organizations are substantially less likely than are individuals to engage in rapidly adaptive behavior. Instead, mature organizations are inclined to rely on rule-based standard operating procedures (SOPs) designed to insure that a specific set of stimuli will invoke a specific response (Cyert and March 1963; Allison 1971; Stewart, Hermann, and Hermann 1989; Anderson 1992).

Political analysts are generally usually not concerned about figuring out precisely what will occur, but rather in reducing the very large set of *possible* future events to a much smaller set of *plausible* events. Point prediction in politics is unnecessary because the individual or organization can prepare for multiple contingencies simultaneously: for example when playing chess, one doesn't prepare for an attack on a single piece, but against multiple possible attacks on multiple pieces. Multiple contingencies may also arise in circumstances where it is rational for an actor to behavior randomly or random behavior can arise from vagaries in health, complex bureaucratic

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[2] The paper will not deal in any detail with forecasting systems that depend primarily on characteristics of physical systems, such as the Food and Agriculture Organization's Global Information and Early Warning System (GIEWS system) for forecasting famine.

interactions, natural disasters, equipment failure, communications breakdowns and other circumstances.[3]

Political predictions tend to be short term rather than long term. The branching of contingencies, particularly those with random components, causes the set of credible outcomes to expand exponentially with time.[4] The human brain, unable to cope with an exponentially increasing set of options, drastically trims this set, often using rules that attempt to bound the true outcome with "best possible case scenarios" and "worst possible case" scenarios. In addition, human planning in the competitive situations typical of politics is continually and deliberately disrupted by the actions of opponents. Thus, while one may have a long-term plan in mind, it is rare that such a plan is fully implemented.

These factors lead to the primacy of short term planning, and short term regularity, over long term planning. In the case of CHCs, the short-term is typically somewhere between three months and a year. Warnings of less than three months provide insufficient lead time for most non-military organizations to react; in other words, the response to a warning of less three months will look pretty much the same as a response to a situation that develops without warning. "Warnings" for time periods greater than a year generally are confined to identifying trends and "hot-spots" rather than predicting specific events.

In contrast to the extensive attention paid to the accuracy of economic[5] and election forecasts (Gelman and King 1992; *The Political Methodologist* Summer 1994), few formal tests are

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[3] During the 1980s, a common term paper topic in our classes on U.S. Foreign Policy was predicting what would happen to Clark Air Force Base in the Philippines. None of the dozens of carefully researched analyses correctly anticipated the actual outcome: the base was abandoned after being buried in ash by the Mt. Pinatubo volcano.

[4] From Thomas Pynchon's novel, *Gravity's Rainbow*:

> It occurred to him to focus on the European balance of power. … He started in on a mammoth work entitled *Things That Can Happen in European Politics.* Begin, of course, with England. "First," he wrote, "Ramsay MacDonald can die". By the time he went through resulting party alignments and possible permutations of cabinet posts, Ramsay MacDonald had died. "Never make it," he found himself muttering at the beginning of each day's work, "it's changing out from under me. Oh dodgy, very dodgy." (Pynchon 1973,77)

[5] See, for instance, the numerous articles on this topic in the *Journal of Business and Economic Statistics. The Economist* (13 June 1992,75), quoting a study by University of Chicago economist Victor Zarnowitz, notes an average improvement in the mean absolute error of forecasts of about 20% in U.S. Treasury forecasts of GDP, inflation and the current account in the coming year when comparing 1979-84 to 1985-91.

> In a less systematic study, *The Economist* (3 June 1995,70) queried four former finance ministers of OECD countries, four CEOs of multinational corporations, four Oxford students and four London garbage collectors

available in the published literature on the accuracy of forecasting political events in the international arena. An exception is Jensen's (1972) test of the predictive abilities of 171 "foreign policy experts" (journalists, individuals from the departments of State and Defense, academics) on a set of twenty-five questions.[6] Answers were a loose set of categories, such as "unlikely", "relatively likely" and "very likely", which depended on the question. The overall success rate was about 64%, which is considerably better than chance but hardly outstanding. It is interesting to note that this accuracy rate is almost identical to the prediction success of the statistical models in the State Failure Project (Esty et al. 1995). Ironically, the CIA concluded that a success rate of "only about two-thirds" meant that "input from country experts must therefore continue to guide any assessment of the future risks of state failure" (p. iii), while presenting no evidence that human analysts have a better success rate.

In an informal exercise at the end of September 1990, Schrodt had the undergraduate students in his international conflict class make detailed predictions about the state of the Iraq-Kuwait crisis as of the final day of class in mid-December.[7] A large majority of the students (and the instructor) got the prediction wrong, expecting the outbreak of armed hostilities in late October or early November. However, four students—about 10% of the class—predicted the situation in December almost exactly, including the use of the United Nations, the continued allied buildup, and the coalition-building activities of the Bush administration. Short-term prediction is definitely possible.

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about economic trends for the 1985-1994 period. The predictions were not particularly accurate and—as expected—most errors could be linked to extrapolating trends from the early 1980s. As to the impact of expertise, the finance ministers as a group were the least accurate; the CEOs and garbage collectors tied for being most accurate.

[6] A total of fifty-one questions were asked; however, many were contingencies—"If war between X and Y breaks out, then …"—that did not occur so the accuracy of the prediction could not be evaluated. The Jensen study dealt with predictions on the order of one to five years.

[7] See Kugler, Snider, and Longwell (1993) for a more systematic analysis of real-time predictions in this crisis.

Categories of Early Warning Failure

Early warning failures stem from a variety of different sources. In this section we present a typology of the six modes of early warning failure—strategic deception, conventional concealment, institutional ignorance, reflexive response, exogenous shifts, and systemic complexity—and assess the extend to which these are likely to affect the forecasting of CHCs. These categories, which apply generally to the problem of institutional forecasting of political and social behavior, rather than solely to the problem of forecasting complex humanitarian crises, are roughly ordered with respect to the amount of information that is available for forecasting: In the case of strategic deception, information actually reduces the likelihood of correct prediction, whereas in cases of systemic complexity, all of the required information may be available but the implications are not understood. In dealing with CHCs, strategic deception is probably the least important source of error; institutional ignorance is probably the most important. However, most CHCs with a significant political component are likely to involve some elements of all of these sources of error.

Strategic Deception

Strategic deception occurs when there is an explicit attempt by some parties to provide misleading data about the character of future activities. Because this information is specifically designed to lead an analyst to a conclusion that is contrary to what will actually occur, successful strategic deception leads to a situation where the availability of more information actually *reduces* the likelihood of a successful prediction. Strategic deception requires a high level of coordination and expertise and is therefore likely to occur only in CHCs that either have a significant political component, such as those involving sudden genocide or ethnic cleansing, or are initiated by the outbreak of a civil war between well-organized antagonists.

There is a substantial literature on strategic deception and it provides a fascinating "exception that proves the rule" on the importance of patterns in predicting political behavior. The well-studied examples include Germany's Operation Barbarossa in W.W.II (Whaley 1973), the Allied deception of Germany prior to the D-Day invasion (Brown 1975), and the Egyptian-Syrian deception prior to the 1973 October War (Handel 1976). A successful deception involves the

elaborate creation of a "world" that makes sense to the organization being deceived. Summarizing the reasons for the success of the Barbarossa deception that preceded the German invasion of the Soviet Union in 1941, Whaley concludes:

> I suddenly realized that the Wohlstetter model [of strategic surprise being due to noise] was a quite inappropriate representation of BARBAROSSA surprise. Stalin (and almost everyone else) had been surprised not because the warnings were *ambiguous* but precisely because German intelligence had managed to *reduce* their ambiguity…. [Hitler's] cunning "ultimatum" stratagem served to eliminate ambiguity, making Stalin quite certain, very decisive, *and wrong*…. Stalin's false expectation was the direct effect of Hitler's campaign to manipulate his victim's information, preconceptions, and decisions. (Whaley 1973,242; italics in original)

Wohlstetter's (1962) study of the successful Japanese surprise at Pearl Harbor emphasized the signal/noise problem in information processing, whereas in a strategic deception, the signal of the adversary's actual intentions is hidden not through noise or secrecy, but by an alternative explanation for events.

Part of the deception in Barbarossa involved convincing the Soviets that German troop movements were part of a plan to invade Britain. In reality, that plan that had been abandoned months earlier. To further confuse matters, the Soviets were led to believe that Barbarossa itself was a deception directed against the British, protecting German plans to invade Britain (Whaley 1973, 173). In the successful "Bodyguard" deception plan preceding D-Day, the illusion was fine-tuned to the knowledge and pattern recognition of the German intelligence agencies, which the British could monitor because they had broken the German communications codes.

Because of the high level of organizational sophistication required to implement strategic deception—both in determining a model of how an opponent will interpret information, and then in generating information which matches that model—large-scale deceptions at the level of Barbarossa or Bodyguard are very unlikely to occur in CHCs, which usually take place in situations characterized by considerable political chaos. In contrast, *small-scale* deception at the local level—"tactical deception"—is probably the norm, particularly when human rights violations are involved. Dead civilians are "terrorists," the former residents of vacant villages "must have decided to move," and food aid diverted by officials was "stolen by bandits." Such explanations are treated with appropriate skepticism by experienced IGO monitors, NGO field workers, and

journalists, but occasionally find their way into official reports. As a consequence, the filtering of sources for reliability, and the use of multiple independent sources, is always advisable.

Conventional Concealment

Conventional concealment is substantially simpler than strategic deception because the actors involved attempt only to conceal their future intentions, rather than actively creating misleading information. The resulting early warning failure occurs because of the absence of sufficient information to forecast events. This is frequently assumed to be the most common source of forecasting error but it is probably the least important cause of error in the current information-rich environment. There is a surprising consensus in contemporary assessments of the early warning problem that a lack of data—if this is taken to mean the total sum of information available to state, NGO, and IGO actors—is *not* a major impediment for early warning.

A dramatic illustration of attempted concealment is found in the case of the Rwandan genocide, which on the surface would appear to be a situation where concealment—notably the need of the perpetrators of the genocide to disguise their plans from the future victims—would have made information unavailable. Yet in assessing this situation, Ruso (1996) observes that the appropriate facts were available (but incorrectly interpreted) as early the UN Rapporteur's Report in 1993 (Deqni-Ségui 1994). Ruso concludes:

> [T]he authors answer "Yes" to the question, "Did those with the capacity to prevent and mitigate the genocide have the information from which such a conclusion might be drawn?" In fact, they note that specific information about plans and conspiracies towards this end was picked up by the UN system, most significantly in the notorious "Black File" of January 1994. (Millwood 1995) (Ruso 1996:8)

As the Rwanda situation illustrates, the mere existence of information does not mean that it will be available in a timely fashion to individuals interested in early warning, or that it will interpreted accurately, or that the warning will be acted upon. The fact remains, however, that in most situations, the required evidence is available.

Institutional Ignorance

An institutional ignorance situation occurs when there is ample documentation, in readily available sources, that a change is occurring in the system, but the institutions that should be responding to that change ignore the evidence. Evidence can be ignored for many reasons: an institution may have alternative priorities on which to focus, the analysts within the institution may have cognitive biases that hinder their ability to observe and interpret a signal correctly, bureaucratic rivalry between organizations that are nominally working on the same problem may inhibit the appropriate exchange of information, or the institution may not want to pay attention to the evidence. The contemporary literature on early warning (e.g., Davies and Gurr forthcoming; Schmeidl and Adelman 1998) provides numerous critiques of the difficulties found in integrating early warning and response in complex bureaucratic institutions.

This is clearly a *major* source of early warning failure as well as a critical source of failures by organizations to act on warnings from outside the organization; it will be discussed extensively below wen we deal with bureaucratic and political impediments to early warning. As we will note in that section and in the conclusion, many of these constraints simply must be taken as "given." For instance, it is quite clear that in the current political environment the United States has no interest in having the United Nations acquire a well-funded and centralized bureau for the collection and analysis of information relevant to political early warning. Furthermore, the United States also has sufficient influence in the United Nations to prevent the creation of such an agency. This situation will not prevent early warning efforts from occurring in other institutional settings, but it will constrain how and where they exist.

Reflexive Reaction

This "failure" occurs when the international community or some other agent intervenes as the result of a warning and prevents the predicted event from occurring. In the words of Guilmette (1997), "successful prevention erases the proof of its success." Discussing the impact of the Canadian International Development Agency (CIDA), Guilmette notes:

> We may never know how many bloody conflicts have been headed off and how many crises have been prevented from generating because assistance, in conjunction with the actions of local governments, provided the strategic ingredient needed to maintain or restore the balance between two communities in the nick of time. *In short, anticipating conflicts and nipping them in the bud is a process which, to the extent that it is successful, will tend to obscure its own successes.* (Guilmette 1995:18; emphasis in the original)

The problem of reflexive prediction is also frequently cited—often in less-than-credible circumstances—by intelligence agencies to justify their effectiveness: "I could tell you about our successes, but then I'd have to kill you."

Because reflexive failures involve a counterfactual—that is, one would have to know whether a CHC would have evolved in the absence of actions by the international community—the frequency of these situations is very difficult to assess. This assessment is further complicated by the fact that the international news media are far more likely to cover catastrophic failures of humanitarian relief efforts than they are to cover modest successes. Zimbabwe, for instance, is generally acknowledged to have dealt quite effectively with the drought conditions in southern Africa during the mid-1990s, but this achievement received relatively little attention outside of the specialized community of experts in development and famine relief. Zimbabwe's efforts were so successful, in fact, that news coverage of Zimbabwe tended to focus on "ordinary" political issues such as land-tenure and corruption, mentioning the drought only in passing. Comparable conditions in Mozambique, Sudan, and Somalia, in contrast, led to mass starvation and as a result attracted considerable attention from both the media and the international community.

In our opinion, the problem of reflexive response should be kept in mind when evaluating the effectiveness of early warning—particularly early warning systems that are dependent primarily on journalistic sources such as wire services stories—however, it is not an insurmountable concern. National and international agencies are not shy about reporting their success stories and considerable information about "dogs that did not bark" exists within the technical reports of national, NGO, and IGO relief and humanitarian agencies. If appropriate aggregation and comparison techniques were used, some of these cases might even be evident in the journalistic record. (There is probably sufficient evidence in open sources to show that Zimbabwe and

Mozambique experienced similar climatic stress in the mid-1990s but this had very different consequences for the two states, for instance.) The difficulty of analyzing the success stories is limited by the relatively small sample size—in all likelihood cases of failed response to early warning far exceed the cases of successful response—but more attention should be paid to this issue.

Exogenous Shifts

An exogenous shift failure occurs when the system is affected by factors that the analysts were not monitoring, nor were expected to monitor. The nature of what is "exogenous" depends entirely, of course, on the character of the organization doing the forecasting: To an agency concerned with the effects of climatic change, political changes are exogenous; to an group focusing on political issues, climatic change is exogenous.

The most common exogenous factor discussed in forecasting CHCs is environmental stress. The potential role of environmental change on social behavior—particularly conflict and population movements—has been analyzed in a number of studies (e..g, Bennett 1991; Homer-Dixon 1991, 1994; Rice, Snow, and Jacobson 1992; and Schmandt and Clarkson 1992). Traditionally, studies of environmental stress have focused on population stress and competition over natural resources such as water, minerals, and fisheries. In many respects these differ little from classical international realist treatments of resource conflict, although they tended to have a more sophisticated understanding of population dynamics and the finiteness of resources. The importance of these factors is reflected in the institutional stability and effectiveness of the Food and Agriculture Organization's (FAO's) Global Information and Early Warning System (GIEWS), for the early warning of famine that is frequently cited as a possible model for political early warning.

Recent work, in contrast, has focused on more complex issues, particularly those associated with the possible implications of global warming and large-scale changes in land use such as desertification, degradation of agricultural land, and deforestation. The effects of these changes are often seen first in "low politics" issues such as economic stress on marginal communities (e.g.,

nomads, indigenous peoples, and subsistence farmers), rural famine and eventually refugee movements. Those stresses sometimes later escalate into "high politics" event—the 1969 "Soccer War" between El Salvador and Honduras and the escalation of the Ethiopian civil war in the late 1980s are two examples—but indicators of environmentally-induced stress can usually be found well before the outbreak of major conflict.

In some cases, however, political changes can also be "exogenous." For example, the dissolution of the Soviet Union clearly had profound effects on the incidence of instability in the Caucasus region during the mid-1990s, but the political troubles that led to the demise of the Soviet Union were only weakly influenced by the core problems leading to conflict in that region. From the perspective of forecasting, the dramatic transformation that occurred in 1991 would have to be factored into any model of conflict in the Caucasus, but it is probably not necessary (or practical) to develop a fully interacting model that looks at the effects that conflict in Armenia, Azerbijan, Georgia had on Moscow.[8]

Two points can be made about the importance of exogenous shifts to early warning. The first is that many of these are effectively step-level changes that involve little or no feedback. This means that while forecasting models may need to be adjusted across such a change—some factors that were very important before the changes may be unimportant afterwards, and vice versa—the models do not need to incorporate the change *per se.* Because major transformations are also relatively rare—the end of the Cold War is clearly the most important for many political forecasts; the current (mid-1998) global economic crisis could conceivably become another (as was the earlier "OPEC decade" and Third World debt crisis in some development models)—such adjustments are relatively infrequent.

Second, there is already information available for forecasting short-term environmental changes, and these forecasts are generally available. The GIEWS model has been refined to the point where it is used in policy implementation; most of the predictions about the meteorological

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[8] Chechnya, in contrast, probably would require such feedback given the large number of Russian troops directly involved in the conflict.

impact of the recent El Niño/Southern Oscillation event were fairly accurate. Due to satellite monitoring and remote sensing, the information available for the modeling of environmental conditions has increased at least as much as that available on political and social behavior. Substantial debate continues on long-range forecasts—witness the controversy surrounding issues such as global warming, desertification and population trends—but most of those debates involve forecasts for time scales at least an order of magnitude greater than the time horizons of concern in political early warning.

Systemic Complexity

Early warning failure due to systemic complexity occurs when there are multiple, more or less simultaneous, changes which are all monitored appropriately, but whose synergistic effects are incorrectly forecast. In such crises, the whole is greater (or more damaging) than the sum of the parts. Systemic complexity is particularly problematic for forecasts that rely primarily on historical precedent. In a situation involving relatively rapid social and technological change—as characterizes much of the developing world—the relevant precedents may be unavailable. This can also apply in the industrialized world, as the generally unanticipated collapse of communism in Europe in 1989-91 demonstrated.

Historical examples may also be insufficient to create empirical regularities because of "Van Creveld's Law":

> [W]ar consists in large part of an interplay of double-crosses [and] is, therefore, not linear but paradoxical. The same action will not always lead to the same result. The opposite, indeed, is closer to the truth. Given an opponent who is capable of learning, a very real danger exists that an action will not succeed twice *because* it has succeeded once. (Van Creveld 1991:316; italics in original).

More generally, work of the Santa Fe Institute on the so-called the "El Farol Problem" (see Casti 1997) has demonstrated that systems of adaptive utility maximizers generally do not exhibit regularized behavior *because* they look at history. In computer simulations, such agents tend to show quasi-chaotic behavior that is *not* predictable. If the political world consists solely of rational

adaptive agents, there is little point in trying to make predictions based on past behaviors.[9] There are undoubtedly some forms of international behavior (for example international exchange-rate behavior) for which this is true.

As we note above, however, these situations are the exception rather than the rule: political behavior is generally predictable rather than surprising. Neither organizations nor individuals can sustain a high level of novel behavior for any length of time, and soon revert to SOPs and personal routines. Ironically, predictions can structure political behavior irrespective of their accuracy. Because planning requires prediction, the complexity of political behavior is constrained by its participants' ability to predict. From a purely statistical standpoint, the political world is very predictable and adjusts itself to reduce uncertainty.

The political world is perceived as random because we disproportionately notice its uncertain aspects. In fact, we experience a truly *random* world only in nightmares, bad *avant garde* films, post modernist exegesis, and after ingesting controlled and illegal substances. Imagine, for instance, a mob of pitchfork-wielding peasants marching on a government building and pulling down a fence. Ah, a violent demonstration, we conclude. But the peasants take the fence posts, build fires, and roast sausages using the pitchforks. Aha, a picnic. Then from the building comes a blare of trumpets and a young man wearing a tuxedo appears beside a young woman in a long white gown. Hmm, well, maybe this is a wedding. Seeing this, the peasants put down their sausages, level their pitchforks at the couple, and rush forward. Well, maybe it's a riot after all, with a break for lunch. But then the woman raises her hand and the peasants stop, form large circles, and dig frantically at the pavement trying to plant turnips.

Such a scenario reads like a bad dream, perhaps induced by a dinner of sausages and turnips. But even this sequence is far from truly random—from this brief description, the reader has probably invoked an elaborate mental image using associated patterns of social behavior. For

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[9] Predictions could still be made on the basis of other characteristics of the system—for example, the effects that economic or technological changes have on the utility functions of the actors, and even predictions about the *range* of strategic outcomes. But in the absence of a completely specified model and comprehensive information, there is little point in trying to make point predictions in a chaotic system.

example, how wide is the street? What are the peasants wearing? What does the facade of the building look like? Does the gown have lace and a veil? None of these details were supplied but your mental image probably contains them.

"Random" is not the same as "unexpected." When one speaks of "anarchy," "disorder," and "unpredictability" in social behavior, this only rarely refers to true randomness but instead to transitions among highly patterned modes of behavior. A "riot" is a form of regularized behavior with predictable characteristics (e.g. shouting, large crowds, looting, attacks on police, etc.) as much as a "parade" is a regularized behavior. The amount of information required to specify a riot is probably similar to that required to specify a parade: the rules for proper behavior in a riot (that is, riotous behavior) are merely different from those governing behavior in a parade.

Our assessment is that systemic complexity is very important in the *theories* underlying early warning—and it will also be significant because of the role it plays in some major forecasting failures such as Europe 1989-91—but it is relatively unimportant in the forecasting of CHCs. To the extent that it is meaningful, it affects the prediction of the *onset* of a CHC more than it affects the forecasting of the effects of that crisis. The fact that the Khmer Rouge embarked in a program of auto-genocide in Cambodia 1975-77, for instance, was difficult to anticipate; indeed, nothing similar occurred in Laos and Vietnam, despite what would appear to be similar circumstances. However, once that genocide was underway, its characteristics and consequences—for example, on refugee flows and the inability of any domestic political opposition to stop the killing—were both precedented and predictable. Systemic complexity tends to force a social system to make a sudden jump to an unexpected mode of behavior, but once in that mode, the response of the system tend to revert to the predictable.

Institutional Response to Early Warning Failure

The problems confronting institutional response to these various sources of failure generally fall into three categories: cognitive, bureaucratic and political. Cognitive factors include both problems of perception—which are discussed extensively in the foreign policy decision-making

literature—but also failures to use the appropriate precedents and theories. Bureaucratic factors are *general* characteristics of bureaucratic decision-making that impede the effectiveness of early warning: we will argue that the most important of these is the inherent tendency of intelligence agencies (and any other bureaucratic unit that derives its power solely from the collection and analysis of information) to try to reduce competition. Political factors are those related to the specific policies of individual states or organizations, particularly major powers with an influence over the agenda of IGOs such as the UN. These are generally related to the sources of error as follows:

	Cognitive	Bureaucratic	Political
Strategic Deception	X		
Conventional Concealment	X		X
Institutional Ignorance		X	X
Reflexive Response		X	X
Exogenous Shifts	X	X	
Systemic Complexity	X		

Cognitive

The cognitive constraints on early warning refer to the inability of individual analysts and decision-makers to correctly process the information that is available to them. There is very large body of research on this issue, with Jervis (1976), Lebow (1981) and Vertzberger (1990) providing surveys of the key problems and concepts in the political arena, and Kahneman, Slovic and Tversky (1982) providing more general critiques.

A useful general distinction to make in assessing the effects of cognitive problems on early warning is between inductive errors and deductive errors. Inductive error occurs in the context of case-based reasoning—the most common forecasting technique used by individuals and organizations (see May 1973, Neustadt and May 1986, Khong 1992)—and happens when the situation is in some sense "unprecedented", so that there are no relevant cases on which to base a prediction. The "auto-genocide" in Cambodia in 1975-77, and the rapid collapse of communist regimes in Eastern Europe in 1989-91 are good examples of inductive error.

Deductive error, in contrast, occurs when the *models* used by the analysts—whether consciously or implicitly—fail to make the correct prediction. Because complex deductive models are found only rarely in policy analysis, these deductive failures usually involve fairly simple "models"—often little more than one or two if-then statements. However, at a larger scale, the application of an inappropriate theoretical framework—for example assuming that a political movement is driven by realist "balance of power" considerations whereas in fact it is driven by a nationalistic ideology (e.g. the Vietnamese resistance to the United States in 1960-1975) or religion (the Islamic Republic of Iran) is also a case of deductive failure.

In terms of institutional response, inductive failure is most likely to be relevant when an early warning model relies (often explicitly) on an analogy that is not accepted by the actor who must respond to the warning. An excellent example of both the power and errors of analogy are found in George Bush's mobilization of the international coalition to expel Iraqi troops from Kuwait. After a bit of rhetorical experimentation, Bush decided to use the Munich analogy to explain the necessity of international intervention against Iraq: Saddam Hussein was Hitler, Kuwait was the defenseless Czechoslovakia, and if the world failed to respond, Iraq would only expand further to eventually—if our member of Congress in 1990 was to be believed—conquer the world (no small feat for a country with a population of 16-million and a GNP equal to that of Kentucky). Bush got his anti-Iraq coalition.

But then the analogy failed. After the decisive defeat of the Iraqi forces, Saddam Hussein was supposed to retreat to a bunker, commit suicide, and be replaced by an Iraqi Konrad Adenauer who

would lead an acquiescent new regime that would outshine even Kuwait in its commitment to democracy and international cooperation. Things didn't work out that way, and probably the better analogy would have been much closer at hand: The Islamic Republic of Iran, which had persisted in going its own way for a decade despite international condemnation, major power boycotts, military defeats and economic decay. The Khomeini analogy would not have carried the rhetorical power of the Hitler analogy, but it would have been a better forecast.[10]

A useful example of deductive failure can be found in the theories that were used to explain the mother-of-all-CHCs, the Sahelian famine of the early 1980s. At the time, many researchers (and many international aid agencies) attributed this wide-spread famine to an irreversible process of "desertification", possibly enhanced by a pattern of global warming. Under this theory, the appropriate response would be to help the population adapt to the new environmental conditions, in the meantime providing emergency food aid and assistance in relocation.

An alternative theory, however, argued that the Sahelian famine, while triggered by drought, had been seriously exacerbated by a number of social policies, particularly in the agricultural sector. The drought, rather than reflecting a long-term change, was merely a short-term manifestation of the high climatic variability in the Sahel region, and would eventually be replaced by more favorable conditions. The famine, in contrast, was the result of various governmental policies that had broken down the social mechanisms through which the Sahelian populations had coped for centuries with recurrent drought. Under this model, the appropriate response would be to provide short-term aid to deal with the immediate effects of famine, but also to try to stabilize the region politically and to reverse policies that had discouraged agricultural production. This approach was used in Mali, for example, and resulted in an increase of rice production from

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[10] The Iran analogy is probably evident only in hindsight. While the authors disagreed with Bush's Munich analogy at the time, we—along with many critics of Bush—were suggesting instead analogies to the U.S. and Israeli intervention in Lebanon or possibly even to superpower interventions in Vietnam and Afghanistan. The complete collapse of Iraqi military resistance, coupled with the post-defeat stability of the Hussein regime, made these analogies just as inappropriate as Bush's comparisons to Munich.

150,000 tons in 1987 to 450,000 tons in 1994 (Guilmette 1995:40).[11] Current scientific evidence (*Science* 31 July 98), meanwhile, provides little support for the original desertification theory.

Bureaucratic

The inability of bureaucratic organizations to appropriately anticipate crises and to respond to information has long been studied in the fields of political science and organizational behavior; Wohlstetter (1962), Cyert and March (1963), Allison (1971), and Janis (1982) are among the classics in this field. The general problems of organizational information processing that are discussed in these works apply, with few if any modifications, to the early warning problem in CHCs. This is particularly true for highly-institutionalized organizations such as the United Nations and its affiliates; it is less true for NGOs, which typically have a much flatter organizational structure.

Rather than repeating the lessons of these earlier works, this section will focus on two issues specific to early warning of CHCs: the competition between IGO early warning efforts and the efforts of national intelligence agencies, and the ambiguity in the information-gathering and operational roles in NGOs.

The competition between national intelligence agencies and UN-related early warning efforts has been noted by a number of individuals, albeit usually not for attribution.[12] In conversations, for example, the much-lamented demise of the UN's Office for Research and Collection of Information (ORCI) has been widely attributed to a desire by the United States to limit any ability of the UN to develop an independent sources of intelligence and analysis. The UN is not alone in this targeting—United States intelligence agencies are at least as vicious in undercutting each other's efforts as they are at dealing with foreign opponents (see for example Johnson 1989, 1998; Moynihan 1998; Olmstead 1996)—but the net effect of this bureaucratic competition is to

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[11] Increased rainfall and the overthrow of a Soviet-style regime in 1991 doubtlessly also contributed to this improvement.

[12] In assembling material for this paper, we noticed that our very best anecdotes about inter-agency competition have come from private conversations; most of the stories we have on paper are found in documents that boldly state "NOT FOR CITATION" on the title page. We will respect the confidences of both sources; in any case, our assertion about the existence of bureaucratic competition is presumably uncontroversial in the community to which this paper is addressed.

substantially reduce the availability and influence of early warning in IGOs which are subject to the influence of major powers. Intelligence agencies will consistently attempt to limit access to information and discredit the analysis of the IGOs, thereby limiting their potential impact.

This characteristic is, unfortunately, probably inherent in the nature of intelligence and analysis. Knowledge is power in any bureaucracy. But in the intelligence community, knowledge is the *only* source of power. An international development agency, for example, can offer a variety of goods and services to its national and international constituencies: facilitating the delivery of food aid to a distressed region assists not only the recipients of the aid, but the farmers who produced the food, the companies that transported it, the NGOs responsible for distribution, and the foreign ministries and parliaments of the countries supporting the program. An intelligence agency, in contrast, has only a single consumer—the decision-maker—and a single product. If the analysis provided by an IGO is identical to that of the agency, that information is redundant; if it is different, the agency may be shown to be wrong. In either situation the agency is better off without the competing analysis.

In this environment, high-visibility early warning operations in IGOs are unlikely to succeed, even in the post-Cold War environment. This conclusion has thus far been well-supported by the empirical evidence. That leaves four bureaucratic niches for early warning projects:

- Operationally-oriented projects that survive "below the radar" in IGOs with clear needs for such capabilities (and claims of specialized expertise), for example, UNHCR, UNDHA, and FAO.
- Nationally-sponsored projects in wealthy countries that do not have a strong intelligence agencies, for example Switzerland, Sweden and Japan;[13]
- NGOs, either in support of operations or as independent early warning projects;
- Projects based in academic research centers.

Surveys of the contemporary early warning projects found in Davies and Gurr (forthcoming), Schmeidl and Adelman (1998) and FEWER (1998) confirm that this is exactly the mix of efforts that is currently found. For example FEWER's March 1998 "Inventory of Early Warning Projects" listed ten projects based in academic institutions (all in North America and Europe), four

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[13] The Swiss FAST system (Kohlschütter and Baechler 1997) is one archetype for such a project; the long-term Swedish support of the Stockholm International Peace Research Institute, while not directly involved in early warning, is another.

projects within NGOs,[14] three projects in regional IGOs (the EU, OAU, and OCSE), and only three in the UN family.

The positive aspect of these small-scale projects is that they exist at all: they are ants in comparison to the elephants of the intelligence agencies of the superpowers, but when enough ants are gathered, they can have an impact. This potential impact is further enhanced by the recent coordination made possible by efforts such as ReliefWeb and FEWER. Nonetheless, the impact is relatively limited.[15]

The necessity of associating most early warning efforts with organizations who are primarily concerned with operational matters also limits the scope and ability of those efforts. Operational agencies are primarily concerned with short-term issues—monitoring ceasefires, moving food, providing aid to refugees, documenting human rights abuses—and predictions about the future necessarily are a secondary consideration, particularly in an environment of decreased funding and increasing demands.

In evaluating the UNHCR early warning experience, Dmitrichev observes

> [T]he concept of early warning has over the last several years suffered from something akin to collective disillusionment, resulting from a diminishing faith in chances of successful prevention activity, with negative repercussion on research related to these topics. [This] is connected to ... the close linkage usually established between "early warning" and "prevention". The emphasis on preventive results has led to a situation where lack of preventive actions has often been considered to be a function of early warning failure. In fact it was failure to take action on the basis of available information which often led to the uncontrolled exacerbation of an emergency situation. Instead of actually strengthening the need to study these issues from a different perspective, this emphasis in turn took attention away from building a reporting mechanism that would fulfill the tasks of providing better knowledge, understanding, analysis and response options to a developing crisis situation. (Dmitrichev 1996:2)

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[14] FEWER's list may substantially understate the number of NGO early warning projects. Schmeidl (1996), for instance, lists twelve NGO projects. In addition we suspect that almost all relief-oriented NGOs—CARE, Save the Children, Catholic Relief Services, Médecins sans Frontiers, Oxfam, etc.—employ some form of early warning analysis, albeit often not by that name, for the purpose of operational planning. Many of these organizations are linked through ReliefWeb, although because of their operational focus (and probably skepticism about existing early warning methodologies) few have been involved in formal early warning efforts at this point.

[15] Arguably the impact of any early warning efforts—including those of the superpower intelligence communities—is limited in comparison to the influence of the electronic broadcast media such as CNN and the on-line news services. Unfortunately, these media do little systematic early warning, although they frequently engage in unsystematic, informal analysis of the "talking heads" genre.

In conferences and conversations, individuals involved in humanitarian relief efforts have repeatedly emphasized that the post-Cold War environment already presents more challenges than they can handle and early-warning—particularly with experimental methods that have no proven track-record—has to be a secondary consideration.

Andre Goodfriend[16] echoes this concern in arguing that the UN system has a greater need for decision-support system that focus on assessing the likely effectiveness of various policy options, rather than early warning per se. He quotes a 1995 UN Joint Inspection report (JIU/REP/95/13-A/50/853) that is quite pessimistic in its assessment of early warning:

> In the Inspectors' view, independent analyses/early warnings, no matter how useful they are to serve their own purposes, do not facilitate concerted and effective preventive actions of the United Nations system on the basis of a common understanding of the problems.

Political

A final constraint on the implementation of early warning systems is the political. By this word we mean the possibility of the early warning conflicting with the current political priorities of various state and IGO actors, rather than the bureaucratic politics that occur within and between organizations that are independent of specific policy. Early warning is not a politically neutral act. DeMars observes:

> When humanitarian organizations, acting autonomously in pursuit of their principled mandates, collect and analyze information in internal conflicts, they increasingly impinge on the security interests of the warring parties. The information they gather in order to understand and influence the humanitarian realist of *who lives* may also reveal and open to outside control the security reality of *who rules*. (DeMars 1997:228, emphasis in original)

Furthermore, if we accept the premises of the "preventive diplomacy" literature (e.g., Cahill 1996; Lund 1996), effective early warning is possibly one of the *most* politically effective strategies that can be employed in the contemporary globalized, wired and democratic international political system. This can cause two problems.

The first, and rather obvious, issue is that early warning may conflict with the policies of certain states. In most cases, this results in the "warning" being completely ignored: A tragic case

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[16] Posting to the EWNET-L list, 10 June 1998.

of this is currently being played out in Kosovo, where analysts have warned for years of a risk of ethnic conflict, in highly conspicuous fora,, and yet where the international community has taken no effective action. As Dmitrichev noted in the previous quotation, warning is not the same as prevention.

If a state feels that early warning presents a sufficiently great challenge to its policies—particularly covert policies—it will discourage any early warning activity. While the involvement of French intelligence services in the Rwandan genocide is still murky, it is reasonable to assume that those agencies would not have welcomed closer monitoring—to say nothing of an accurate forecast of genocide—in central Africa. Because of its close relationship with Israel, the U.S. would feel similarly uncomfortable with early warning in southern Lebanon—however much UNIFIL could make good use of such information—and Russia the same in the Caucasus. In this respect, the U.S. destruction of ORCI should perhaps be seen as a compliment on what the U.S. perceived that U.N. analysts might be able to achieve..

The other side of this critique is the assertion that early warning should not be done because it runs the risk of changing history in a fashion unanticipated by the researcher. The typical invoked image is that of some romantic revolutionary movement—led perhaps by a contemporary version of the young Mao Zedong or of Che Guevara (curiously never an Idi Amin or Pol Pot)—whose place in history is undone by some meddling statistician with a computer.[17] This critique is largely confined to the academic community; individuals in IGOs and NGOs having already committed themselves to trying to change history, or at least little bits of it.

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[17] Brecke (1995) alludes to—without necessarily endorsing—this debate:

> What stirs concern are interrelated matters of what conditions we are receiving early warning about and what might need to be done about them. ... Early warning of a guerrilla war treads on even touchier ground. Would an early warning capability increase even more the advantages held by those in favor of the status quo? Does the UN have any business in struggles for control of the state apparatus other than providing mediation and possibly some humanitarian relief? What kind of precedent might we be settling with respect to state sovereignty? … Early warning of violent conflicts so that conflict-prevention activities can be initiated causes anxiety for many. (Brecke 1995:322)

Based on our experiences at academic conferences (much of that experience coinciding with Brecke's), this refers to a large body of verbal criticism likely to be encountered when early warning models are presented. As Brecke observes, this can come from either a revolutionary or status quo perspective.

The initial impulse is to dismiss such concerns as naive: For good or ill, the advice of early warning researchers will be ignored, particularly when coming from outside of the policy community. Maybe, but not always: the academic writings of a once-obscure 19th century sociologist spurred mass revolutions throughout the 20th century and the seemingly abstract theories of academic economists move billions of dollars today. At the present time political early warning systems raise little more than eyebrows, but with a few conspicuous successful applications, that could change.

The more sophisticated response is to note that by taking this position, one has accepted a profoundly conservative view that somehow we live in the best of all possible worlds, and that any interference in that world will necessarily leave things the worse off. The Rwandan genocide, in this view, is merely an unfortunate step towards a brighter future that will provide a greater good to a greater number. We disagree and, given that many proponents of noninterference identify themselves at least as political liberals (in the U.S. sense), if not radicals, there seems to be some logical inconsistency in their position.

Better instead to accept that yes, an early warning model could alter history, just as a well-written essay could alter history. Paine, Marx and Engles, and Kennan have certainly demonstrated the latter. Early warning is potentially a political act with potential political consequences. Therefore one should treat the early warning enterprise with care and with an awareness of how the information might be used. But doing nothing also has potential political consequences.

Conclusion

Based on this analysis, we can draw several conclusions about the future of early warning of CHCs, and more generally about the role of early warning in motivating responses to political change in the international system.

First, while the problem of early warning is difficult, it is not insurmountable. Furthermore, the increased availability of information in a timely and inexpensive form (at least for individuals and organizations in industrialized states) makes early warning more feasible now than at in any

time in the past. In particular, the reports of IGO and NGO field workers—appropriately filtered—are an important untapped source of information for early warning purposes. NGOs increasingly provide access to quality information about stressed populations—for example, refugees and minorities—that is not available from other sources. However, these reports must be carefully filtered for bias and attempts to deliberately manipulate the early warning system,[18] and might well be adjusted (either informally by a qualitative analyst or formally in a statistical system) to account for the political sophistication, timeliness, reliability, and sensitivity of the source.

At the same time, operational constraints suggest that successful early warning operation must be able to use *existing* sources of information—including journalistic sources—rather than requiring new information. Experience has shown that early warning systems that require a great deal of customized information will not be supported by individuals who are primarily concerned with operational concerns. This was true even in the well-funded U.S. Department of Defense projects (Hoople, Andriole and Freedy 1984, Laurance 1990), and these constraints are even more salient to over-worked and under-funded NGOs and IGOs.

For political reasons, early warning is likely to remain a decentralized enterprise. This is not necessarily a bad thing. As long as a common pool of information is available—and the World Wide Web had already done this for individuals within range of an internet connection—it is not clear that there are economies of scale in early warning. Duffy (1995) notes that the diffuse character of Internet-based early warning information is an asset rather than a liability, allowing many different "voices" to be heard. While various groups might find it useful to share techniques, there is little evidence that a single model or even a single approach to forecasting will

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[18] In Schrodt (1995) one of us suggested that a major potential weaknesses with an Internet-based early warning system was its vulnerability to manipulation. Shortly thereafter a concrete example of this occurred in a survey done by the editors of the computer magazine *Byte* (September 1996: 32) who attempted to use the Internet to poll users on the future of various operating systems. The survey failed due to the efforts of users of two relatively obscure operating systems—undoubtedly coordinating their effort through email networks—to "stuff the ballot box," leading the *Byte* editors to end their article with the frustrating observation: "And, to the individual who voted over 80 times in the survey (your IP address is 198.182.4.224): Get a life." While ideologies rarely evoke the level of emotional commitment shown by computer users to their operating systems, the example is instructive with respect to the ease with which Internet sources of information can be exploited and the likelihood of this manipulation occurring. Recent *New York Times* stories on the use of the Internet to manipulate stock prices provide another cautionary tale.

be appropriate for all questions. A system that forecasts the outbreak of ethnic cleansing in an area such as the former Yugoslavia or Rwanda/Burundi may need to be quite different than a model that forecasts the outbreak of hostilities along a militarized border such as Kashmir or southern Lebanon. Geographically-specific systems that account for differences in government, history and culture may be appropriate as well. Small-scale projects, preferably multinational in scope and with multiple sources of funding, should be less susceptible to political manipulation, and the existence of a large number of projects will avoid the problem of investing a large amount of resources into a limited number of techniques that may not work out.

There are, however, small-scale projects must overcome two problems in order to have a significant impact: credibility and access. (Overcoming these problems is, of course, part of the agenda of FEWER, as well as other NGOs such as Amnesty International and International Alert.) The experimentation that is provided by multiple projects means that some projects will have a better record of providing accurate forecasts than others, and the early warning community (ideally in cooperation with sympathetic decision-makers in IGOs, NGOs, and neutral states) needs to establish norms for evaluating the various systems. Once that credibility has been established, these projects need to work with decision-makers (and possibly with the elite news media) so that the forecasts can be used in a timely fashion.[19] In some cases, researchers may require greater sensitivity to operational issues if they want their forecasts to be used (rather than forecasting as a purely academic exercise): not everything that can be predicted will necessarily be of interest to organizations.

Finally, some comments are in order on the relationship between statistical methods of forecasting and the traditional qualitative, non-statistical methods. Throughout this paper we have deliberately avoided specifying what techniques are best suited for early warning; further, we believe that virtually all of the observations we have made here apply to both quantitative and qualitative methods. While our own project (Schrodt and Gerner 1994, 1997) focuses almost

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[19] Unfortunately, if a forecasting system is known to be used in policy-making, the news sources that it is dependent upon might become subject to manipulation. This is another argument in favor of using diffuse, rather than focused, information sources as input.

exclusively on statistical methods, we regard those indicators as a supplement to, rather than a replacement for, traditional qualitative early warning methods.

Because political behavior is a human activity (in contrast, for example, to the weather or earthquakes), human understanding and intuition are likely to be powerful tools in predicting that behavior. Early warning is also an "ill-defined problem" (Moray 1984, 11) within a complex system, where neither the relevant variables nor the relevant processes have been fully, or even adequately, identified. We also face the practical constraint that purely statistically-based warning systems are unlikely to be accepted in the largely qualitatively-oriented policy community (Laurance 1990).

At the same time, there are clearly some individuals in the policy community who would prefer quantitative indicators: Statistical early warning research has been driven (and funded) at least as much through the policy community as through academically-oriented basic research, with the State Failure Project (Esty et al. 1995) being only the latest of many such projects. Statistical forecasting methods fill two gaps that are inherent in human-based qualitative approaches. First, while human intuition is a valuable tool in understanding political behavior, cognitive biases can blind an analyst to a situation that is rapidly changing despite his or her expectations. Major United States intelligence lapses such as the inibility to anticipate the establishment and stability of the Islamic Republic of Iran and the failure to predict the collapse of communism in Eastern Europe illustrate the extent to which this problem can affect even well-funded and experienced analysts. Second, statistical methods are capable of consistently monitoring a much larger amount of information than can a human analyst. A system based on computerized analysis of machine-readable sources can operate 24-hours-a-day without fatigue, distractions, political pressure, or committee meetings.

Finally, statistical systems designed specifically for early warning *may* be able to utilize general models of behavior that can apply in a number of different circumstances, rather than depending on the area-specific knowledge of individual analysts. This does not eliminate the need to employ analysts with area-specific knowledge after a potential problem has been detected. Warning about

a problem is not the same as understanding it: When your car's thermometer goes to "HIGH," you are well-advised to stop the engine, but the thermometer reading alone cannot determine whether the problem is a broken fan belt, a leaky radiator, or a malfunctioning thermostat. Statistical systems are never going to replace area-specific knowledge, but they may usefully supplement it, particularly if a large number of areas are being monitored.

The qualitative opportunities for receiving information relevant to early warning has increased dramatically in the past five years with the availability of inexpensive machine-readable commercial news sources and the proliferation of reports available from IGOS and NGOs via the internet. During this same period the challenges have also increased, for example in the potential dissolution of some states in the post-Cold War period and the appalling resurgence of genocidal outbreaks such as those witnessed in Cambodia, Rwanda and Bosnia. Consequently we believe that there is an important role for the development of quantitative indicators. To the extent that an area is adequately monitored by electronically-readable sources, real-time quantitative forecasting using machine-coded event data is quite inexpensive and can easily operate in the background as a supplement to qualitative forecasting.

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