Briefly stated, my purpose here is to explore some of the major uses and limitations on the kind of intellectual activity identified as "metamodelling," using athletic coaching to illustrate, and hopefully to clarify, the argument. Because current usage tends to vary considerably, a precise meaning for "metamodelling" must be developed and stabilized in a way that will (1) identify a significant kind of intellectual activity, and (2) provide an adequate point of departure for the analysis while remaining reasonably consonant with usage. To accomplish this, the meaning assigned to "metamodelling" as well as the meaning of "modeling" generally, will be established within the context of a complex set of initial assumptions relating to human intellectual performance — in effect, a theory of knowledge. Clearly, not all of the intellectual apparatus involved in the analysis required to fix the meaning of terms in this way can be elaborated in a brief essay. But if the argument is to be convincing for reasons that are themselves convincing, (if the conclusions reached with respect to metamodelling are to be taken seriously), the basic construction of knowledge from which the analysis proceeds, and on which the conclusions therefore depend, must be sketched with enough detail and precision to allow reasoned agreement or disagreement. The discussion therefore begins with a brief summary of the construction of "knowledge" employed as a point of departure, establishes the meaning of "modeling" and "metamodelling" within that epistemological context, and concludes with a discussion of the uses and limitations that attach to such "metamodelling."

Knowledge

For the kind of methodologically-oriented inquiry that occupies us here, knowledge is most usefully construed as organized human experience, meaning simply that knowledge is created by imposing a logical structure, an organized pattern, upon the flow of human perceptions or experience. The pattern may be static or dynamic, particular or generalized, empirical or normative. If the pattern is generalized in form, the implications of applying (accepting) it can be calculated and used to manage real world affairs, to anticipate or control events in the environment — in the latter case by directing human actions. In these terms, knowledge is a product of the application of logic or mathematics to human experience, a formal or calculable pattern linked to past experience by an appropriate set of assumptions. Of course, the application of a logical pattern to experience is not itself a problem within logic. The validity of the products of applied mathematics must be assessed by reference to non-logical (as it turns out, pragmatic) criteria. At a minimum, the use of logic (except by logicians for purposes within logic) always involves judgment and argument rather than simple calculation. Given human dependence upon the sensory apparatus for information about the world, and the need to express the results of organization in a language that is itself an artifact of the human intellect, the validity of knowledge claims must be argued using pragmatic criteria. Such criteria are in turn contingent upon normative judgments, stated in the form of preferences or priorities.

So construed, knowledge can be regarded as simply a special kind of instrument for achieving human purposes. Such knowledge finds its raison d'être in the purposes for which it can be used and is assessed or evaluated by reference to those purposes. Absent human purposes, there would be no way to evaluate knowledge claims, and in fact no reason to seek for knowledge beyond satisfaction of idle curiosity. Criticism and improvement of knowledge (conceived as organized experience), like the criticism of any other human tool or instrument, depends on the purposes which knowledge is meant to serve. Since achieving human purposes necessarily involves human actions, the knowledge that is required for metamodelling must enable the user to direct human actions on defensible grounds — the apparatus must be corrigible over time out of past experience. An analytic framework that is adequate for dealing with such knowledge must, at a minimum: (1) identify, in suitably generalized terms, the purposes that must be achieved if human actions are to be placed on defensible grounds, (2) summarize the relevant human capacities available for fulfilling those purposes, and (3) provide a metaleague or theoretical structure (precisely equivalent to the kind of "theory of play" available
to coaches in well-developed sports) that will show how those purposes can be achieved within the limits of (a) available capacity and (b) any other relevant constraints.

Development of a set of intellectual purposes that can provide a defensible or justifiable base for action requires prior acceptance of an overall purpose for the human enterprise. That rather formidable-sounding task turns out in practice to be relatively simple. For humans, the overriding purpose that knowledge must serve is always and everywhere the maintenance and/or improvement of the conditions of life of some human population. The genetic inheritance is inadequate even for species maintenance; it must be augmented by creating knowledge and learning how to apply and improve it — use it to direct human actions to the achievement of human purposes. That much agreed, the principal corollaries to the overall purpose set for the human intellectual enterprise are readily determined. At a minimum, knowledge must include all of instruments necessary for: (a) predicting future events from presently available observations; (b) controlling future events (producing or preventing them) by human actions; and (c) making choices. That list need not be exhaustive, though at present there seems no good reason to extend it. And even if extension does prove necessary in future, so much of what is significant in human affairs is covered by those three purposes that an analytic apparatus that can deal with them effectively will remain an absolute necessity.

Four types of human capacity, all widely distributed within the species, are essential for creating knowledge adequate for fulfilling these three primary purposes, and thus achieving the overall goal of maintaining and/or improving the conditions of life of some human population. First, the neural apparatus must be able to discriminate, and thus impose a basic ordering on the incoming flow of perceptions; second, the system must be capable of generalizing particular conclusions or judgments, a capacity that is much strengthened (but made riskier) by the availability of language; third, it must be able to calculate, to draw logical inferences or explore the content of generalized propositions or combinations of generalized and particular propositions; and fourth, the individual must react affectively, must care sufficiently about differences in conditions of life to act in ways that will change them — members of the species cannot be wholly indifferent to environmental differences else the quest for knowledge becomes pointless — and unlikely to occur.

The task of creating such knowledge is much facilitated by two other characteristics of the human situation, each a commonplace. First, every individual lives in an ongoing knowledge system and at least some of that knowledge can be justified or defended: there is no need to begin with a tabula rasa. Second, all that is needed to fulfill the stipulated human purposes is the capacity to deal with recurring or repetitive events. Both conditions are essential. First, if it were necessary to begin the search for knowledge anew with each individual, or with each event, very little could be achieved in a human lifetime, and species survival would be unlikely; second, the human intellectual apparatus is incapable in principle of dealing with any event that is wholly unique.

In addition to (a) a supply of logics that incorporate a variety of logical or relational terms and a range of carefully defined symbols, and (b) a language, (both of which must be taken as given here), a number of different types of patterns is needed to fulfill the purposes set for the knowledge creating enterprise. Five such patterns are fundamental: (1) concepts or classifications, which enumerate the shared or "distributed" attributes of class members — ships, and shoes and sealing wax, and so on; (2) forecasts, which link two or more events through formal rules so that one event can be used to predict the other under stipulated limiting conditions — linking the blooming of two different types of flowers by a specified time period, for example; (3) theories, which also link two or more events by rule, but which include an assumed causal relation among the events and thus fulfill an essential requirement for directing actions — connecting the use of fertilizer to plant growth, for example; (4) priorities or preference orderings, which when applied select the preferred outcome (the outcome whose selection can be justified or defended) from within the set of outcomes available for choice — preferring deafness to blindness, other things equal; and (5) policies, or action programs (comprised of theories and serving to reify priorities) that provide a way to achieve the preferred outcome under stipulated limiting conditions — a recipe for making a cake, or a procedure for performing a medical operation, is a good example.

Briefly summarized, the knowledge-creating enterprise emerges within the analytic framework as an ongoing effort to organize past experience into formal patterns that can be combined with experience and observation and thus used to fulfill the basic purposes required for maintaining and improving the human condition. In that context, the development of a field of knowledge becomes a matter of articulating and elaborating organizing assumptions that will order past experience in humanly useful ways — usefulness being deter-
mined by the kinds of purposes that can be fulfilled using the patterns created. To produce knowledge, formal patterns or calculi are used to organize past experience; the kind of pattern that is applied and the kind of evidence that is needed to justify accepting and using it depend on the purpose for which the knowledge will be employed. Knowing that one flower generally blooms earlier than another is useful for predicting when the second flower will bloom, for example, but useless as a guide to actions intended to speed its blooming. The overall normative purpose that the theory of knowledge was designed to fulfill provides the criteria needed for assessing the results of inquiry. The dynamics of the knowledge system are found in the calculating capacity of formal logic. If the elements and processes contained in a calculus can be linked firmly to the world of observation, if an adequate set of rules of correspondence can be devised, a useful and corrigeable piece of knowledge is created.

Modeling

"Modeling," which is most commonly defined as the creation of a formal representation (pattern) of some aspect of reality or experience, appears in context as simply another way of talking about human knowledge-creation. That greatly simplifies the task of articulating the potentialities and limitations of any kind of modeling, for the importance of knowledge in human affairs hardly requires serious argument. The discussion can therefore concentrate on the possibilities and limitations that attach to modeling generally, and metamodeling in particular.

The first point requiring emphasis with respect to both modeling and metamodeling is the aggregate character of the concepts. Because knowledge must serve a variety of purposes, each requiring different instruments and subject to different criteria of validity, a concept that lumps them all together is virtually worthless for analytic purposes. But in everyday usage, "model" may refer to any type of pattern included in the knowledge system. That has the effect of lumping all of the basic intellectual instruments, of treating them as a single category. But if no justification can be provided for accepting and applying knowledge until the purpose the knowledge is expected to serve has been stipulated, then models whose function or purpose cannot be identified clearly and accurately cannot be tested or validated. Indeed, the ambiguity introduced by using "modeling" in so loose a manner largely accounts for the willingness of economists, among others, to insist that predictability is an adequate test of theory, or to claim, following Milton Friedman's famous essay on the methodology of economics, that any model may contain false assumptions -- an assertion that is tenable with respect to forecasts but grossly mistaken with respect to the instruments required for projecting the effects of human actions (theories).

Metamodeling, which can be defined tentatively as the application of formal patterns to second-order phenomena -- to the application of logic rather than to directly experienced real world events -- is subject to all of the limitations common to modeling in general. Most of them are a consequence of the logical character of models. A formal logic is basically a set of rules for manipulating nominally-defined symbols. Logical structures have no relation, qua logic, to the world of observation. Applications of logic to the world of experience require a theoretical linkage between abstract symbol and process and the substance of real world experience, a linkage that must be justified in the same manner as any other knowledge claim. Further, all logics have limits: at most, they rise to the level of a "Turing machine" that can reproduce its own content fully -- logics cannot "create" in the human sense of that term. Logic has enormous power in human affairs, for it provides a way of calculating implications of accepting given sets of propositions (some of which must be generalized) that can be validated formally in absolute terms. But use of that power to deal with the world of experience is contingent on the creation of an acceptable theoretical link between both the formally-defined symbols in the logic and the processes incorporated into the logical system on the one hand and the substance of human experience, adequately conceptualized, on the other.

The role of logic in the creative phase of knowledge-production is extremely limited. Some formal inferences will be employed in the overall process but they are interwoven heavily with non-formalizable "judgements," often of a very complex nature. Thus all conclusions relating to the adequacy of supporting data for a general proposition, to the adequacy of the conceptual apparatus used to structure a descriptive account, to the relevance of data to any specific proposition, or to the defensibility of a preference or priority, require such "judgments." Moreover, the concept of "rational" judgment, to the extent that the meaning of "rational" is equated with formal validity, is either inconsistent or meaningless, and therefore cannot provide an escape route from the predicament. In sum, the process used to make judgments, like the process by which knowledge is created, remains opaque. Both require an "external" reference point, a pragmatic basis for
their justification. Formal modeling may assist in the creative process, as J.S. Mill's "methods" simplify the search for causal relations by eliminating from consideration some of the factors in a list of potential causes selected on theoretical or other non-formal grounds. Nevertheless, so long as the factors that limit the use made of formal models are respected, there are excellent reasons for seeking to extend the practice of modeling, and particularly the creation of metamodels, as full as possible.

The major constraints on the use of formal systems in knowledge development, which are best summarized in terms of the requirements for producing and justifying human "judgments," can be sketched here only briefly. The nature of "judgment" is most clearly visible in a context supplied by the techniques available to humans for reaching conclusions. Three fundamental procedures are available to perform that task. First, decisions can be based upon direct observation or measurement, but only if they refer to propositions in the form "X was (or was not) the case." Second, conclusions can be generated inferentially, by logical calculation from an established (or assumed) set of propositions, some of which must be generalized in form. In all other cases, conclusions are based on the functioning of the neural apparatus but the specific content of the constituent elements (assumptions) used in the decision process remains unknown. In such "judgments," the neural system functions like a "black box" whose products can be observed but whose processes remain hidden. A judgment can therefore be regarded as a conclusion reached by the functioning of the total intellectual system, but the elements of the system involved in any particular judgment cannot be isolated. All experientially-grounded conclusions depend ultimately on such judgments. Although judgments will certainly be produced by formal processes within the neural apparatus, the full set of assumptions from which the inferences are drawn are not, and cannot be, known; the neural system, to put the point as clearly as possible, can (indeed, must) be selective. For that reason, the judgmental process defies formalization; no incomplete system can be formalized. Acquiring the capacity to deal effectively with the need to make and assess judgments is therefore a problem common to every knowledge system.

The nature of the problem, and the character of the available evasion, can be established quite precisely by treating knowledge-production as a "black box" function involving the whole intellectual apparatus. In principle, the content of a black box is opaque to human observers. As a process, then, knowledge-creation appears to the human observer as precisely equivalent to the operation of the natural universe: the functioning principles, if indeed there are any, are "unknowable" — even if they were correctly identified, there would be no way to demonstrate the correctness of the identification. The process of judgment, then, lies beyond human capacity to replicate and incorporate into a formal logical structure. Indeed, there is no way to actually "test" a judgment, for what is tested in the ordinary meaning of the term "test" is a combination of a set of assumptions and the formal validity of an inference from that set of assumptions to a particular conclusion. If those assumptions cannot be stated they can hardly be tested. The only feasible test of a human judgment is another human judgment, a comparison of the reasoning and evidence that can be marshalled to support different judgments when they appear, carried out by competent human judges. Such "tests" proceed by "pushing back" the assumptions made until one or both of the protagonists reach a point where no further evidence, or relevant knowledge, can be produced. If no basis for agreement has been found when that point is reached, there is nothing further to be said until additional evidence is available. Whether in physical science or in human affairs, including normative inquiry, the court of last resort is always the consensus of the community of informed and competent persons, arrived at by that relatively simple process. The members of that community may be very difficult to identify, and in many causes they will not agree. In the absence of consensus, the case in question can only be regarded as moot.

Some way of evading the limit imposed by the need to rely on judgments must be created, otherwise formal modeling is of little value. The "solution," which is a commonplace, is to ignore the processes by which judgments are reached and concentrate on replicating the conclusions. Since that is the only procedure available for dealing with "black boxes," at least to the extent that they are truly opaque, it must be accepted as one of the fundamentals in every knowledge system. The task of modeling appears from that perspective as an effort to create a logical apparatus that reproduces the external characteristics of "black box" performance. There is no justification for assuming that the axioms incorporated into the logical system replicate the internal logic of the "black box," nor is there any need to do so. So long as such models are created with a specific purpose in mind, and linked firmly to the conduct of human affairs, successive applications (and the elimination of discrepancies as they appear) can lead to intellectual tools of immense power and
accuracy.

Of course, if the situations or experiences being modeled show wide ranges of variance, or if the elements in an organized pattern are capable of learning and therefore altering their behavior, formalization may be severely restricted. For example, a computer model cannot, or more precisely, should not, be expected to control performance of an appendectomy so long as appendices display the degree of variance in size, location, configuration, and so on that is presently encountered in real cases. Future improvements in conceptualization may reduce, or even eliminate such variations, but if that does not occur, the programming requirements for developing an adequate feedback system to guide a computerized operation would be prohibitive. Training a physician to perform appendectomies is, for the moment at least, a much simpler and cheaper task.

The great virtue of computerized models (knowledge) lies in their capacity to build very large complexes, combining large numbers of patterns, while maintaining the logic coherence of the overall structure. In a sense, that potential is the major contribution to the improvement of the available knowledge supply that has appeared thus far in human history. However, knowledge remains of a different order from strictly formal propositions, in the sense that adding two and two is qualitatively and significantly different from adding two apples and two apples. Moreover, knowledge claims are always in some degree uncertain because of the arbitrary closure required to produce the generalized propositions that make calculation or formal inference possible. Finally, modeling cannot deal with the kind of knowledge that is acquired from experience without conscious awareness, though modeling may in some cases at least help to articulate its content.

Knowledge is likely to remain dependent upon human judgment into the indefinite future and therefore to remain in some degree limited and constrained. And there are further limits on the development and application of models (on knowledge creation) worth attending. First, if Godel's theorem is correct, there is an outer limit to size of systems of interacting variables that can be created while remaining certain that the logical integrity of the overall structure has been maintained. Second, every knowledge claim rests in principle on a set of normative judgments, and their peculiar character serves as a different kind of limit on the formalization or modeling of human experience.

The need to base knowledge systems on normative decisions is far and away the more important of the foreseeable factors that limit future modeling. First, in a definitive formalization of knowledge, future human reactions to changes in the conditions of human life would have to be anticipated completely and included in the formal apparatus. But there is no way to anticipate what those conditions will be since they are at least partially contingent upon interim human creativity, and future human reactions to changes in potential cannot be projected because they are presently trans-experiential — they will be made under conditions of life that have not yet been experienced, and refer to options that are also beyond present experience. If that limitation is ignored, the resulting knowledge system becomes an intellectual prison rather than an evolving human instrument, and potentially at least a self-fulfilling ordinance rather than an improvable product of human judgment and capacity.

Second, the justification for a normative conclusion, the kind of argument that should be persuasive to a competent critic, will vary with knowledge and circumstances. The basis for preference is always the differences in the conditions of life of the human population affected by action — homo mensura is an essential component in any set of normative assumptions. But the human life that is the basis for justifying preferences does not comprise a definable continuum, no standard unit for measuring that continuum is possible, and one life is not wholly interchangeable with another, even with respect to the present. The features of human life that matter in normative judgments vary like the features of a painting that are taken into account when the value (not the price) of a painting is being assessed. Procedures can be developed for making the comparisons needed for preferences, but they are valid only with respect to particular times and places and for specified classes of persons — they cannot be culture free or absolute. And the procedures that are used to evade judgment with respect to "empirical" conclusions, or matters of "fact," such as the range of statistical conventions commonly accepted in systematic inquiry, cannot be employed with respect to normative conclusions. Ultimate reliance on formal procedures, or on their products, is effectively ruled out. Normative judgments must be argued. Regular adherence to a fairly simple rule would, however, maximize the value of present and future models: they must be linked firmly and clearly to human purposes and human experience and human actions, thus avoiding what might be called in our own era the "theoretical physics" syndrome, and in the event of a conflict between model and experience it is always the model that yields.
Metamodelling

Metamodelling, which amounts to "the modeling of modeling," can be very difficult to separate from first-order modeling. Perhaps the most useful and decisive criterion for differentiating the two is that metamodelling focuses on human efforts to deal with the world, rather than on the world as directly experienced. Thus if metamodelling may be concerned with human efforts to describe, describing is not itself a part of metamodelling. Similarly, and perhaps less clearly, the "reduction" or integration of theories, as in the physical sciences, might be the object of an effort to create a metamodel, but would not be part of the activity. On the other hand, every metamodel must assume a causal linkage between human actions and specific outcomes, and thus must qualify as an empirical theory, therefore "theorizing," in that limited sense, is an essential element in metamodelling generally. Succinctly stated, metamodelling focuses on human intellectual performance, seeking to assess and improve it — a function that involves both normative and empirical considerations. Without that basic purpose, metamodelling would itself be unimprovable, a pointless academic exercise. And in fact, fulfilling that purpose constitutes metamodelling's unique contribution to the development and use of human knowledge. There is no way to criticize and improve human intellectual performance other than by relating it to actions, no way to improve actions save by reference to their purposes, and no way to link actions to purposes except through a metamodel. Metamodells are absolutely essential in every inductive knowledge system.

Athletic coaching, whether of individuals or teams, provides an ideal vehicle for illustrating the purposes, methods, and limitations inherent in metamodelling, for it is relatively familiar to a very wide population and yet fairly easy to analyze. Thus in the context of athletics, it is obvious that the primary function of the coach, the reason for creating the kind of metamodels that coaches employ, is to improve the performance of particular players. Team improvements may not be guaranteed by improvements in the performance of individual players, but they are unlikely to appear absent such improvements. Even improvements in coaching are contingent upon player improvements. Without a player (and a game to be played) there would be no need for coaching, no basis for improving coaching capacity, and no evidence to show that an improvement had in fact occurred. However many levels of analysis may intervene between the metamodel and the human actor whose performance is being assessed, that actor's performance provides the point of departure for the analysis, and provides the evidence needed to assess a proposed metamodel — the purpose of the human actor whose activities are being modeled, and not the purpose of the metamodeler, serves as a base for criticizing and improving metamodels.

The way in which athletic coaches proceed with their functions is also highly instructive for prospective metamodelers. Analytically at least, they begin with the overall purpose of the game in question, seeking to break down that overall purpose into a set of ancillary or subordinate purposes whose fulfillment is necessary and sufficient for fulfilling the overall purpose. That process may be carried to several levels of contingency, depending upon the nature and complexity of the game in question. In each case, the primary concern of the coach is to arrive at a set of purposes for which the necessary and/or the sufficient preconditions of fulfillment can be specified. Those preconditions must be satisfied within the limits of human capacity and the rules of the game, plus any relevant normative and empirical constraints common to the wider society. The metamodel produced will link each of the purposes arrived at analytically to its appropriate preconditions for fulfillment. In a complex apparatus, those preconditions may have their own preconditions (as physical capacity may be needed to perform specific functions well and appropriate exercises can be designed to produce the requisite capacity).

So construed, metamodelling has enormous potential value, for it is essential for criticism and improvement of human knowledge, but it is subject to some severe and unavoidable handicaps. Not only must all of the requirements and constraints that limit any form of modeling be satisfied, but there are two additional impediments that are different from, and much more difficult to deal with, than those encountered in first-order modeling. These extraordinary hazards are an unavoidable byproduct of the nature of the metamodelling enterprise (of the reasons why it is undertaken and the nature of the target activity) and of the peculiar character of the resulting models. The first of them is a testing problem that rapidly becomes unmanageable as the number of levels of analytic separation between the human performance that is the object of concern and the metamodel that is being constructed increases. The second, which has even more serious potential implications for the user, is a normative problem that emerges when the number of levels of analysis is increased beyond two (when the metamodel changes from coaching players to coaching coaches of players, for example) for that greatly increases the complexity of the task of assessing
the validity of the metamodel.

Ignoring for the moment the problems associated with testing and justification, metamodels perform two primary functions in systematic inquiry, both essential for improving the power and reliability of the available knowledge supply. First, as noted earlier, they provide the machinery that is needed for testing the validity of empirical knowledge claims. Including a causal linkage between human actions and specified consequences in the set of assumptions that make up the metamodel creates an instrument that satisfies the minimum conditions for testing and improving action programs intended to achieve specified purposes. Second, and perhaps even more important, metamodels provide a way of transferring knowledge between and among different fields of inquiry. A metamodel is always generalized in form, and it deals with a class of human actions; it can therefore be assumed to apply to any member of that class, wherever it may occur. The repertoire of metamodels currently available can be regarded as a kind of “tinkertoy” set of elements that can be put together in any combination so long as testing or validation requirements are met. Perhaps the clearest examples of this kind of cross-fertilization capacity are found in athletics, where coaches in one sport can learn from those who coach a different sport quite frequently and usefully. If the activities share certain commonalities, that allows patterns created in one field to be employed in another even though the two kinds of activity, taken as a whole, are quite different. Several limited metamodels may, in effect, be combined to produce a wider structure with greater power and applicability.

The potential for generalizing among fields, particularly as the level of abstraction is increased (from metamodels to meta-metamodels, and then to meta-meta-metamodels and so on), is also the source of one of the major hazards associated with metamodeling — loss of testing capacity. Even at the level of a causally-linked abstract structure intended to improve a single player’s performance of a particular class of actions, such as “blocking” an opponent in football, evaluation of the metamodel may be quite difficult. The reason is fairly simple: the player becomes, within the metamodel, a “black box” of uncertain performance characteristics lying between the actions of the coach and the improved performance (by the player) expected to follow. The uncertainty or risk involved increases dramatically when a team or group of players is involved, as almost every coach of an athletic team has learned at cost at some point in the coaching career. At succeeding levels of analysis or modeling, the population involved becomes increasingly diverse, the number of black boxes whose actions can interfere with the expected outcome increases, often quite dramatically, and the uncertainty factor grows increasingly larger and less manageable. At some point, often not very far down the road to high-level abstractions, the apparatus loses its potential value to the user.

The other major hazard associated with metamodeling is the danger that the creator or user of such systems will lose sight of the normative dimension of the activity that is being modeled — bearing in mind that the reason for doing the modeling is to improve the quality of the activity. Analytically, every human action has both an empirical and a normative dimension; adequate criticism, or justification, of the action must take both dimensions into account. An action is precisely equivalent to a choice, and an adequate assessment of the action must take into account the choice that has been made. The physician who did a splendid job of setting a broken arm while the patient bled to death from a severed artery would be unlikely to receive the plaudits of his colleagues — though some applause might be heard from the morticians in the audience. Even at the level of simple or direct modeling, it is sometimes difficult to keep in mind the full set of normative factors that must be assessed. Concentrating on playing according to the rules of the game, and ignoring largely or even completely the wider normative context in which all athletic events (and all human actions) occur, is commonplace, but a serious error nonetheless. It is highly visible in the extreme case, beautifully exemplified in the aphorism made famous by a professional football coach, now deceased: “Winning isn’t everything, it’s the only thing.” It may be less visible, but is no less common and no less an error when metamodels are created in such fields as business administration, education, or economics, that limit “normative” concerns rigorously to the equivalent of the “rules of play” in sports, ignoring the social, or the wider “human” context in which such activities occur.

There is no way for the metamodeler (or modeler) to avoid such problems; all that can be demanded is awareness of the principal dangers and integrity in dealing with them on the metamodeler’s part — a sustained effort to maintain the validity of the metamodel at the highest possible level, and to make that level known to everyone involved with its use. What is particularly important, in the light of present-day practices, is that the need for normative assessment
be clearly understood by all concerned. Assuming that the purpose of every metamodel is to improve human performance, and normative assessment is analytically prior to empirical evaluation in judging whether or not an improvement has been made, then such assessments cannot be avoided. Put differently, however strong the justification for concentrating on the empirical or technical aspects of human performance may appear, the person or agency involved in the transfer or use of such technical knowledge must function with awareness of need to assess the normative aspects of the performance. Not to do so would be tantamount to showing a would-be pilot how to take off and fly an aircraft but omitting instruction in how to land the machine.

Of course, awareness is not enough; there must be competence as well. Here, the principal burden of responsibility seems to fall on the broader educational system, particularly in any society that purports to be self-governing. Competence in such assessments is an essential part of public policymaking; indeed, self-government presumes and requires the capacity to evaluate collective decisions and actions with competence and integrity. Responsibility for creating that competence must clearly be fixed somewhere, but it would be absurd to argue that the burden should lie with metamodelers as a class.

Notes: