WHY PUBLIC POLICY SCHOOLS SHOULD TEACH FORESIGHT AND FUTURES STUDIES

A CALIFORNIA 100 WHITE PAPER

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ABSTRACT
With the increasing recognition of big, systemic forces shaping our future such as climate change, economic inequality, structural racism, terrorism, and artificial intelligence, it seems time to reexamine futures and foresight studies. Foresight can clarify our values about what we want the future to be, identify unexpected problems and opportunities, and develop imaginative alternatives to meet the challenges we face. It can also improve the day-to-day practice of public policy analysis.

In the 1960s, three intellectual movements—public policy studies, decision analysis/operations research, and futures and foresight studies—gained attention as ways to improve policy- and decision-making. They had intense periods of development from roughly 1960 to 1990. Policy analysis has now become ensconced in public policy schools at major universities. Decision theory is a staple of the business curriculum. These two approaches focused on manageable, well-defined problems, formal (often quantitative) methods for solving them, and incremental changes. Futures and foresight studies (we use the terms interchangeably) have had a more checkered history with a period of neglect, even disdain, for the past three decades after the dismantling of the Congressional Office of Technology Assessment in 1995, but they have continued their work in some places to provide a broader and more imaginative take on public policy-making that focuses on alternative futures instead of just problem solving. They have also developed a potpourri of methods for thinking about, evaluating, and constructing possible futures.

This paper makes an intellectual case for futures studies in public policy schools. It outlines a pedagogical framework for teaching futures studies. And it suggests a methodological agenda to make futures studies more systematic, replicable and useful—that is, more scientific.

Intellectually, both policy analysis and decision theory are increasingly concerned about possible futures as a starting place for their efforts, and more and more leading scholars in these fields have emphasized the importance of considering a broad range of human values and examining alternative futures. Scholars have also encountered many important policy problems where “deep” uncertainty cannot be handled by standard statistical models, requiring the development of new approaches. Meta-frameworks for thinking about the future such as the XPROW paradigm (eXogenous forces, Policies, Relationships, Outcomes, Weights) and scenario thinking have provided a structure by which to proceed, and specific methods for dealing with future uncertainty have been developed.

It is clear that we cannot always produce models for thinking definitely about the future. Sometimes we have to make do with large pieces of the puzzle missing. We cannot fully know what outcomes are possible. We cannot clearly state our preferences, partly because they are the preferences of future generations. We cannot fully describe causal relationships or obtain the probabilities of events, and we cannot know all the policy alternatives that are possible. But we can make enough inroads on these difficulties to do a better job of preparing for and constructing the future we want. We can study the future. We can construct roads to alternative futures. We can teach people how to do these things.

The California 100 project shows what can be done. The project developed—based upon research from scholars from around the state on 15 policy areas—a common format for thinking about the future in each area using two critical uncertainties about the area’s future and four scenarios built from dichotomizing each one of those uncertainties. These 60 scenarios (four for each of the 15 policy areas) have provided a series of interlocking snapshots of what might happen in California, and they have provided the project with a detailed and comprehensive picture of possible futures. The project has shown the value of thinking about the future and incorporating future and foresight studies into public policy school curriculums.
With the increasing recognition of big, systemic forces shaping our future such as climate change, economic inequality, structural racism, terrorism, and artificial intelligence, not to mention surprises such as COVID-19 and January 6th, it seems time to reexamine futures and foresight studies—terms we use interchangeably. These methods can clarify our values about what we want the future to be, identify unexpected problems and opportunities, and find imaginative paths toward alternative futures that can meet the challenges we face. They can also improve the day-to-day practice of public policy analysis by providing better projections of future conditions affecting public policies.

Three Intellectual Movements: Policy Studies, Decision Analysis, Futures Studies

In the 1960s, three intellectual movements—public policy studies, decision analysis/operations research, and futures and foresight studies—gained attention as ways to improve policy- and decision-making. Two of them gained traction and took off. Public policy studies became ensconced in schools of public policy that reshaped schools of public administration.¹ Decision analysis and operations research methods became mainstays of the curriculums of modern business schools and a part of the public policy curriculum.² Futures and foresight studies continued to develop. But perhaps because of their roots in utopian thinking, perhaps because they dealt with very large and unmanageable questions, perhaps because they required grappling with concerns about values that the field was trying to avoid, or perhaps because they failed to develop the tools and institutions that would propel them forward,³ futures and


³ Much of this futures work was highly speculative and produced outside the framework of the academic disciplines such as Dennis Gabor, 1960, Inventing the Future; Herman Kahn, 1960, On Thermonuclear War; Arthur C. Clarke, 1962, Profiles of the Future: An Inquiry into the Limits of the Possible; Kahn, 1962, Thinking about the Unthinkable; Kahn, 1967, The Year 2000: A Framework for Speculation on the Next Thirty-Three Years; Alvin Toffler, 1970, Future Shock. Two books published by academic social scientists, sociologist Frederick Polak’s The Image of the Future (first published in Dutch in 1955 and in an English edition in 1973) and political scientist Bertrand de Jouvenel’s The Art of Conjecture (1967) were highly idiosyncratic, although very thoughtful and learned. Harold Lasswell’s work (1971, A Preview of the Policy Sciences) proposed an alternative path that combined public policy analysis with futures and foresight studies, but it was not taken. Work on the methodologies for studying the future continued in a few places led by individuals such as Wendell Bell at Yale (Foundations of Futures Studies, 1997), Jerome C. Glenn and Theodore J. Gordon at the Millennium Project (Futures Research Methodologies, 1999—3rd edition 2009), James Dewar at the RAND corporation (Assumption Based Planning: A Tool for Reducing Avoidable Surprises, 2002), James Dator at the University of Hawaii (Advancing Futures: Futures Studies in Higher Education, 2002), Peter Bishop and
foresight studies eventually languished as almost all public policy schools chose to focus on small, incremental, and manageable problems.

Part of the impetus for this narrow focus for public policy schools was the triumph of “incrementalism”—an approach developed by Charles Lindblom and Aaron Wildavsky—as a way to understand politics and public policy. Although the theory of incrementalism began as a description of how policies got made through the political process, it became a theory of how problems could and should be solved. It became an article of faith that big changes don’t occur in the policy-making space. Rather problems could only be dealt with piecemeal. Moreover, the best changes were those that avoided conflict over values by looking for increases in efficiency or “Pareto improvements” in which everyone gained or could potentially gain through some transfers from “winners” to “losers”. In an article on public policy schools in 1985, Aaron Wildavsky summarized and defended this approach in a section entitled the “Virtues of ‘value-free’ analysis”:

“When it is said that schools of public policy teach the practice of incrementalism, I can only respond: ‘Guilty as charged.’ They are meliorative, seeking to move away from known bads rather than toward grandiose goods. Besides being incrementalist, schools of policy are also parochial. They do not study the whole but the parts. They do not necessarily fix the entire difficulty but only those portions over which their clients have some measure of control.”

Another impetus for the parochialism of public policy schools was their desire to develop quantitative skills for students and the credibility that went with quantification by focusing on techniques such as micro-economic analysis, decision-theory, operations research, and statistics. These skills could be most easily applied to narrowly defined and circumscribed problems addressed one by one.

As a way to develop credibility for public policy schools, this incremental, parochial, skill-based approach that avoided discussions of values by focusing on efficiency and Pareto improvements


5 Many social scientists have also focused increasingly on experiments, typically involving narrow problems and questions, as the only way to make reliable inference and to validate policy proposals.

6 Wildavsky, 1985, op. cit., page 34.
probably made sense, but it ignored big and important issues. It also meant that public policy schools focused on problems defined by clients, the solutions clients could implement, and the evaluation of those solutions in ways that made sense to clients. They neglected the possibilities for broader problem definitions, the prospects that the general public and future generations should be their clients, the needs for new ways to generate alternatives, the imperatives for a broader discussion of values, and the opportunities for invention and design that would enlarge the range of imaginable futures.

It has now become apparent that solving problems one by one is not the same as constructing a coherent, livable future. In fact, narrow problem-solving, by default and omission, could construct a future that no one wants. Yet public policy schools still focus a great deal on teaching students how to solve circumscribed problems posed by clients – one of the first steps in the canonical descriptions of how to do public policy analysis is “Define the Problem” or “Understand the Problem.” To be fair, students are often advised to think broadly about the problem and to expand the problem definition if necessary, but the emphasis is still on the problem at hand and narrowing it down to something manageable that matters to the client. As a pedagogical device, this approach might make sense, but it should not be treated as the only way to do public policy analysis.

Ralph Keeney, one of the founders of mathematical decision analysis, ultimately lamented his field’s focus on “decisions” and “problems” instead of “alternatives” and “values,” saying that:

“Many books have been written about decision-making. They tell us how to solve decision problems. They do not tell us how to identify potential decision opportunities. They tell us how to analyze alternatives to choose the best one. They do not tell us how to create alternatives. They tell us how to evaluate alternatives given some quantitative objective function. They do not tell us how to articulate the qualitative objectives on which any appraisal of alternatives must rest.”

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Keeney’s 1992 work on “Value Focused Thinking” iconoclastically developed a new approach that focuses on where we want to go (“values”) and how we can construct ways to get there (“alternatives”) instead of just concentrating on decision problems. That is exactly what futures or foresight analysis tries to do. This paper argues that it is time to bring futures studies back into schools of public policy, public administration, and public affairs.

Differences between Futures Studies and Public Policy Analysis

Futures work differs from standard public policy approaches in two fundamental ways. First, it focuses on alternative futures instead of on policy problems. It assesses the value of those future scenarios, and it develops paths to constructing the best possible future instead of focusing on specific policy problems. The foresight method asks us to consider “what world do we want to live in?” and then it develops ways to get us there. It has the audacity to try to construct the future. Policy analysis, on the other hand, identifies problems in the world and tries to solve them. It is typically more concerned with amelioration and incremental change.

Second, foresight invents and utilizes novel methods for imagining and evaluating the future in the all-too-common situations where there is deep uncertainty that is not amenable to standard statistical modeling and statistical thinking. These methodologies can enrich the practice of public policy analysis because it too requires thinking about the future. Each of these differences between the two approaches is worth exploring in detail.

Alternative Futures Instead of Problem Solving

Imagining the future and trying to construct it is different from considering current problems and trying to solve them. As we shall see, it is more like writing a constitution for the ages than creating a program to solve a problem. This difference between considering alternative futures and focusing on policy problems can be best understood by comparing the eight steps in Eugene Bardach’s Eightfold Path for public policy analysis and the “Future Foresight” method developed by Peter Bishop and Andrew Hines.10 We compare these frameworks because they are representative of each genre,11 and each is a leading approach in its field.

Comparing Bardach’s Eightfold Path and Bishop-Hines Framework Foresight

Every policy analysis involves thinking about the future, and every futures and foresight exercise requires solving problems. So the methods have many features in common—they are...
ultimately complementary to one another. But they are different in what they emphasize and consider. Figure 1 indicates the relationship between the eight steps in Bardach’s Eightfold Path (EFP) and the eight steps in Bishop and Hines’ Future Foresight (FF) method. The “X’s” indicate where the methods overlap, although people can have different takes on this.

Figure 1 – Comparing the Eightfold Path with the Framework Foresight Method

<table>
<thead>
<tr>
<th>FRAMEWORK FORESIGHT – PETER BISHOP AND ANDREW HINES</th>
<th>EIGHTFOLD PATH – EUGENE BARDACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain Description (Framing)</td>
<td>Domain Description (Framing)</td>
</tr>
<tr>
<td>Current Assessment (Scanning)</td>
<td>Baseline Future (Forecasting)</td>
</tr>
<tr>
<td>Alternative Futures (Forecasting)</td>
<td>Preferred Future (Visioning)</td>
</tr>
<tr>
<td>Implications Analysis (Visioning)</td>
<td>Futures To Plans (Planning)</td>
</tr>
<tr>
<td>Change Management (Acting)</td>
<td>Change Management (Acting)</td>
</tr>
</tbody>
</table>

1. Define the Problem | X |
2. Assemble the Evidence | X |
3. Construct the Alternatives | X | X |
4. Select the Criteria | X |
5. Project the Outcomes | X |
6. Confront the Tradeoffs | X |
7. Decide | X |
8. Tell Your Story | X |

Source: Authors adaptation from Bardach and from Bishop and Hines. The X's indicate similar steps.

12 “Although there are differences between the policy sciences and futures studies approaches which require further analysis, there nevertheless is a symbiotic relationship between the two (page 586).” Peter deLeon, 1984, “Futures Studies and the Policy Sciences,” Futures, pages 586-593.
The methods differ in their focus and in their construction of alternatives. In its first, framing step, Bishop and Hines’ FF focuses on a “domain description” such as “transportation,” “the Internet,” “terrorism,” or “democracy” instead of “defining a problem” such as “congested streets” or “terrorists getting on airplanes” as in Bardach’s EFP method. As it moves along, FF does a “current assessment” that is similar to “assembling the evidence” for EFP but it does so for an entire domain and it looks for trends and signals of change. Then, crucially, FF describes a “baseline future” that extrapolates from the current situation and a set of “alternative futures” that try to cover the gamut of what is possible. Bardach’s EFP method “constructs the alternatives.” The word “alternative” appears in both methods, but they have different meanings. In a study of carbon emissions, the FF method describes alternative futures such as rising sea levels, changing demographic patterns, and new forms of technology, but the EFP method designs alternative policy instruments such as cap-and-trade, carbon taxes, or emissions limits that might reduce carbon emissions. The FF method focuses on change in the overall system while the EFP method focuses on the impacts of policy instruments.

The methods also differ in the way they think about values. Choosing the “preferred future” in the fifth step of the foresight method requires a discussion of values in the context of possible alternative futures, while “selecting the criteria” in the fourth step of the Bardach method focuses on the likely impacts of the policy instruments. One could imagine that both methods would consider the same values, but each tends naturally to a particular set of concerns. For the climate change example, the foresight method would ask people to consider various futures in the light of their values—the analysis would be holistic and open to considering any values that seem relevant such as achieving equitable and inclusive outcomes, producing wealth, ensuring well-being, developing skills and enlightenment, maintaining respect and affection among groups, or ensuring biodiversity and stability in the natural world. The EFP method typically asks the policy analyst to think about how the impacts of policy alternatives differ in their efficiency, their burden upon different groups, or their effectiveness.13

Finally the methods differ in the breadth of their aspirations. The sixth step, “Implications analysis,” in the FF method is similar to the fifth and sixth steps, “projecting the outcomes” and “confronting the tradeoffs,” in the EFP approach, but they start from different places—the foresight methods considers an array of possible futures while the policy analysis method considers the impacts of different policy instruments. Finally, the Bishop-Hines FF method is much more audacious than the Bardach EFP method as it tries to “construct” the future by going from “futures to plans” and not just “deciding” to use a particular policy instrument.14

These approaches have different purposes. The Eightfold Path aims to develop a policy or program to solve a problem such as too little housing, congested freeways, lack of adequate

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13 This characterization is presented by the critics of policy analysis such as Popp Berman, 2022, op. cit. and Davis B. Borow and John S. Dryzek, 1987, Policy Analysis by Design, University of Pittsburgh Press. In response to these critics, many public policy programs and textbooks have expanded their consideration of values in the ways suggested by Stone, 2012, op. cit.
14 Each of these approaches has an eighth step concerned with acting—either to “tell your story” in EFP or “change management” in FF to make sure that the desired future is being realized.
A powerful example where future foresight methods displaced policy analysis is the Constitutional Convention of 1787. Initially just a gathering convened by the Confederation Congress—the successor to the Continental Congress that first met in September 5, 1774—to consider amendments to the Articles of Confederation that would solve some problems faced by the Articles, the convention would do much more as the delegates considered the future design and structure of the government of the United States of America. The Confederation’s weaknesses included requiring unanimity for any action, lacking an executive to implement its policies, and allowing the states to deny the national government the resources to provide for defense and the common good. The gathering was intended to develop amendments that would solve these problems. It was meant to be an exercise in policy analysis and policy amendments. Yet within three days of convening, the delegates gathered in Philadelphia resolved to construct an alternative future for the colonies by establishing a new national government.15 In doing this, the delegates explicitly turned their back on their client, the Confederation Congress, and went in a direction that would usurp its powers as they considered the public and future generations as their clients. They also went beyond concerns

15 On the third day of the convention, the delegates endorsed a resolution that “a national government ought to be established consisting of a supreme legislative, executive, and judiciary.” Chapter 5, “A High-Stakes Gamble,” in Richard Beeman, 2009, Plain, Honest Men: The Making of the American Constitution, Random House: NY.
with the efficiency and effectiveness of the Articles of Confederation to concerns with a just, fair, and free society.

Elsewhere, the first author has explored in detail how the Constitutional Convention moved from policy analysis to thinking about the future. \(^{16}\) Here’s a quick synopsis, based upon Madison’s notes, which describes how the delegates developed alternative futures, expressed their preferences regarding them, and ultimately constructed a preferred future.

The delegates speculated and talked a great deal about counterfactuals and the future in an effort to understand the uncertainties they faced. They provided thoughtful arguments and reasons for their perspectives. Because they were talking about the future, the word “will” occurs over 1,300 times and about as often in the first half of the convention as in the second. Because they were also using counterfactuals, the words “would,” “might” or “may,” and “could” appear over 3,000 times and equally in the first and second halves of the Convention. \(^{17}\) The delegates developed scenarios speculating about the future using the future tense (“will”), conditionals (“would”), or words such as “probably” as indicated by these examples from Madison’s notes on the Convention proceedings. In a discussion of suffrage qualifications, James Madison of Virginia says:

“In future times a great majority of the people will not only be without land, but any other sort of property. These will either combine, under the influence of their common situation: in which case, the rights of property & the public liberty, will not be secure in their hands: or which is more probable, they will become the tools of opulence & ambition, in which case there will be equal danger on another side.” (Emphasis added)

Madison’s notes report that Roger Sherman of Connecticut and others predicted that the slave trade would wither away without any encouragement by a tax on the importation of Slaves:

“He [Sherman] disapproved of the slave trade; yet as the States were now possessed of the right to import slaves, as the public good did not require it to be taken from them, & as it was expedient to have as few objections as possible to the proposed scheme of Government, he thought it best to leave the matter as we find it. He observed that the abolition of Slavery seemed to be going on in the U. S. & that the good sense of the several States would probably by degrees complete it.” (Emphasis added)

Charles Pinckney of South Carolina concurred: “If the Southern States were let alone they will probably of themselves stop importations. He [Pinckney] would himself as a citizen of S.


\(^{17}\) “Complete” counterfactuals typically involve an “if” clause followed by the likelihood of something happening. “If we have a strong executive, then the executive would become a tyrant” is an example. The words “might” and “may” are used to indicate a probability and not a certainty as with “would.” The word “could” indicates a possibility. There are not that many complete counterfactuals in Madison’s notes, but they are typically implicit given the context. “Would” appears 1470 times, “may” 700 times, “might” 500 times, and “could” 520 times for a total of 3190 times. Gaillard Hunt (editor), 1902, The Writings of James Madison, Volumes III and IV, “The Journal of the Constitutional Convention,” G.P. Putnam: New York. Available here: https://oll.libertyfund.org/title/madison-the-writings-of-james-madison-9-vols.
Carolina vote for it. An attempt to take away the right as proposed will produce serious objections to the Constitution which he wished to see adopted.” And Abraham Baldwin of Georgia concurred as well: “If left to herself, she may probably put a stop to the evil. As one ground for this conjecture, he took notice of the sect of — which he said was a respectable class of people, who carried their ethics beyond the mere equality of men, extending their humanity to the claims of the whole animal creation.” These speculations did not anticipate the cotton gin that prolonged slavery in the south, but more tragically, they justified the greatest moral catastrophe of the Constitutional Convention—its failure to abolish slavery.

Beyond discussing what the future might bring under various conditions, the delegates also discussed their preferences and what new institutions could be constructed. To deal with these possibilities, their speech also includes instructive language about preferences such as “should” and “ought” and constructive language about obligations such as “shall” and “must.”

“Should” and “ought” are used to express preferences and instructions – the first to indicate an absolute preference or instruction and the second to indicate a strong one. “Should” appears almost 1,000 times and “ought” 500. For example, in the discussion of proportional representation, David Brearly and William Paterson of New Jersey proposed that “all the States should be thrown into one mass and a new partition be made into 13 equal parts.” On the same subject, Alexander Hamilton from New York proposed that “As States, he thought they ought to be abolished. But he admitted the necessity of leaving them [as] subordinate jurisdictions.” And Oliver Ellsworth of Connecticut combined an ought, would, and could in his discussion of the role of the militia:

“The whole authority over the militia ought by no means to be taken away from the States whose consequence would pine away to nothing after such a sacrifice of power. He thought the General Authority could not sufficiently pervade the Union for such a purpose, nor could it accommodate itself to the local genius of the people.” (Emphasis added)

“Shall” and “must” typically appear to indicate a duty, obligation, or intention of someone or an institution to do something in the future. They are about constructing the future. “Shall” appears 1,520 times and “must” appears 310 times, but both appear much more frequently in

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18 References are: Madison (III, 120), Sherman (IV, 267-8), Pinckney (IV, 268), Baldwin (IV, 269).
20 “Should” appears 320 times in the first half of the convention and 660 in the second for a total of 980. “Ought” appears a total of 510 times.
21 Brearly and Paterson (III, 218), Hamilton (III, 221), Ellsworth (IV, 237).
22 In 1800, “shall” was used more than “must” but today “must” is used more. (See Google Books Ngram Viewer for “must” and “shall.”)
the second half of the Convention when the entire Constitution was being drafted. The Constitution itself (without any amendments) uses “shall” 191 times to indicate duty or obligation and the delegates typically use the word in this way.23

These “shall” and “must” statements are examples of what the philosopher John Searle calls “performatives.” They create reality by declarations. Indeed, the Constitution as a whole is an example of making a performative statement that creates institutions, rights, and obligations—what Searle calls a “social deontology”—a system of norms, regulations, roles, and responsibilities.24 For example, human language is used to assign a status function or role to someone or something—the presidency, Congress, the Supreme Court—and other human beings, because of their capacity for language, can understand what is being proposed. If these proposals are mutually agreed upon by groups of people, then social structures can be created over time.

In their concern about the future, the delegates to the Convention not only discussed causal relationships and counterfactuals, they also stated their preferences, and they engaged in a process of the social construction of reality.25 The Convention developed new institutions and it constituted their inter-relationships. There is an important lesson in this: Studying the future not only requires extrapolating from the present, it also requires invention and construction based upon preferences. Among other things, this immediately brings together positivist social science with interpretive and normative political science. It brings the construction of institutions to the forefront of the social science enterprise.

Developing Tools for Imagining and Evaluating the Future

The second major difference between policy analysis and future foresight is the attention paid to methods for imagining and evaluating the future. The Eightfold Path talks about “projecting the outcomes” but Bardach considers it the “hardest step” because of uncertainty about what the future will bring. In some areas (e.g., predictions about the solvency of Social Security trust funds, energy reserves, climate change, and budget deficits), elaborate prediction methods have been developed that have a mixed record of success,26 but there is even more uncertainty about many other areas (e.g., the future of war, democracy, inequality, racism, etc.) The Eightfold Path also talks about “selecting the criteria,” but as noted above, it has often focused on a narrow range of values and concerns.

23 The Constitution never uses “must.” The word “will” only appears three times—twice in the President’s oath of office (“will faithfully execute”) and once to indicate an exceptional circumstance when a state could exercise treaty or war powers (“unless actually invaded, or in such imminent danger as will not admit of delay,” Article I, Section 10). “Ought” does not appear and “should” only appears once.


26 Consider, for example, the debate over “peak oil”—when oil production would peak. Ian Chapman, 2014, “The end of Peak Oil? Why this topic is still relevant despite recent denials,” Energy Policy, 64, 93-101.
Futures methods have confronted the issues of uncertainty and preferences more directly, and they have made some progress, although they have developed more of a potpourri of methods for imagining the future rather than a single recipe, and the fields’ discussion of values is still not very developed, although what has been done has the virtue of being very broad and far-reaching and of linking values directly to the construction of future scenarios.

Broadening our Conception of Uncertainty

So far, futures studies’ biggest contribution has been to broaden our understanding of uncertainty. Figure 2 depicts one influential typology of different types of uncertainty. To start with, consider the three “levels” of uncertainty across the top of the matrix.

Figure 2 – Uncertainty Matrix

<table>
<thead>
<tr>
<th>Location</th>
<th>Level</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistical uncertainty</td>
<td>Scenario uncertainty</td>
</tr>
<tr>
<td>Context</td>
<td>Natural, technological, economic, social and political representation</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>Model structure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technical model</td>
<td></td>
</tr>
<tr>
<td>Inputs</td>
<td>Driving forces</td>
<td></td>
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<tr>
<td></td>
<td>System data</td>
<td></td>
</tr>
<tr>
<td>Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model Outcomes</td>
<td></td>
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</tr>
</tbody>
</table>


Traditionally, social scientists and public policy analysts have thought of uncertainty as statistical uncertainty (the first column under “Level” in Figure 2) where there is a random variable with a probability distribution and the future is some outcome of that random variable. The role of the statistician is to use data on the random variable to get estimates of some major

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features of its probability distribution such as its mean and to characterize the sampling distribution (the “uncertainty”) of the resulting estimates. But “statistical uncertainty” is a particular form of uncertainty because it assumes that much is already known about the phenomenon at hand. It assumes that the random variable can be measured, that a reliable model can be developed about how it is generated in some population, that the variables in the model can also be measured, that a representative sample of outcomes can be obtained for the relevant population from which estimates can be made, that the process generating the random variable will not suddenly depart from past behavior, and that the statistical techniques used to make inferences make proper ones. These are a lot of suppositions and the history of modeling in many fields suggests that they are not always true.

The proponents of Bayesian conceptions of “subjective” probability based upon the axiomatic work of Leonard Savage and others have argued that despite these concerns, personal probabilities can be elicited about any phenomenon so that decisions and plans can be based upon these probabilities. But despite elaborate efforts to elicit such probabilities, research by Kahneman and others has shown that most people are not very good at providing consistent and meaningful subjective probabilities.

Even if assumptions about random variables are true or if probabilities can be consistently elicited, the resulting estimates of outcomes for a system may themselves be highly uncertain with large sampling intervals or confidence intervals. With statistical uncertainty, one of the major tasks—too seldom undertaken—is for model-builders to do a sensitivity analysis to determine how much total uncertainty comes from the models and measurements that are used. The left-hand side of the “Uncertainty Matrix” in Figure 2 enumerates various locations where uncertainty is found in this kind of modeling. These sources of uncertainty include models that fail to capture the context correctly so that they miss important aspects of reality, models that are necessarily simplified to be comprehensible and tractable, models whose technical implementation must deal with limited geographic or temporal detail, inputs to the model that are themselves unknown such as demographic trends or technological innovations, inputs for which no data are available, and ultimately the uncertain value of parameters given limited and error-prone data.

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Scenario uncertainty is the second level of uncertainty in Figure 2. “Contrary to statistical uncertainty, where the functional relationships are well described and a statistical expression of the uncertainty present can be formulated, scenario uncertainty implies that there is a range of possible outcomes, but the mechanisms leading to these outcomes are not well understood, and it is, therefore, not possible to formulate the probability of any one outcome occurring.”35 Scenarios do not try to model the entire process. Rather they try to describe possible alternative outcomes that must be considered by any decision-maker.

A group at RAND, a research organization where much of futures research originated and where it has been moved forward over the past seven decades, describes this as “Level 3” uncertainty where there is “a limited set of plausible futures, system models, outcomes, or weights, and probabilities cannot be assigned to them.” These possible futures are called scenarios. “A scenario does not predict what will happen in the future; rather it is a plausible description of what can happen. The scenario approach assumes that, although the likelihood of the future worlds is unknown, the range of plausible futures can be specified well enough to identify a (static) policy that will produce acceptable outcomes for most of them.”36

There is at least one more level of uncertainty short of complete ignorance, namely “recognized ignorance.” In this case we know so little that it is difficult if not impossible to even describe a limited number of future scenarios. Arguably climate research was in this state in the 1950s as computer models of the weather were just being developed and scientists began to realize how little they knew about the weather. The models were crude, sensors and data were limited, and little was known about short-term, much less, long-term weather patterns. In this situation, it was possible to hypothesize many possible futures, but they went in many different directions with little information or theory to guide which ones made sense.

Futures’ researchers call this a situation of “Deep Uncertainty,” and methods are just beginning to be developed to deal with it. One guiding principle is that under these circumstances decision-making and plans for the future must be flexible, robust, and resilient – one must design a system that can be modified in the future, that includes gathering information to decrease uncertainty as time goes on, and that allows for frequent adjustments to deal with changing circumstances.37

The identification of these three types of uncertainty—statistical, scenario, and recognized ignorance (or deep uncertainty)—may seem prosaic, but once recognized, it becomes clear that many problems are not conducive to statistical analyses, and we need different ways to cope

35 Walker et al., 2003, op cit., page 12.
37 Marchau et al., op cit., is a compendium of methods for dealing with deep uncertainty. An illustration of how flexibility in policies can dominate inflexibility is Peter Linquiti and Nicholas Vonortas 2012, “The Value of Flexibility In Adapting To Climate Change: A Real Options Analysis Of Investments In Coastal Defense,” Climate Change Economics, 3:2, 1-33.
FORESIGHT IN POLICY SCHOOLS

with them. Foresight researchers are working on this problem. One important compendium of methods is Jerome C. Glenn and Theodore J. Gordon, *Futures Research Methodology, Version 3.0* at The Millennium Project which describes dozens of methods. Another is “Beyond Strategic Planning: A Foresight Toolkit for Decision Makers” developed by California 100 and the School of International Futures. “The toolkit is intended as a primer on strategic foresight, with pragmatic tools that enable decision makers and strategists of various stripes to be better prepared for future success under conditions of massive uncertainty and rapid change. It is a collection of strategies that can be used by an organization to create a foresight ecosystem for their routine decision making.” The primer discusses foresight methods that can be used to think clearly about a question, think differently about change, imagine alternate futures and navigate uncertainty.

To the newcomer, these methods—while useful and interesting—often seem ad hoc and disconnected from one another. One of the tasks of future methodological work is developing a better framework within which these methods can be understood. We sketch out an approach later in this paper.

**Thinking about Preferences for the Future**

Considering the future has greatly expanded thinking about preferences because it requires the consideration of time and generations as well as the standard issues of multi-dimensional preferences. There are three strains of literature regarding preferences about the future.

One literature borrows from economics, and focuses on the issue of time. It reduces the problem of time-preference to a one-dimensional “discount rate” – the way in which value received and experienced in the future is converted into value today. This approach assumes that we can use cost-benefit analysis or some other method to reduce various “projects” for the future (e.g., building dams, reducing greenhouse gases, or investing in education) to a set of monetary values of current investment (and consumption thereby foregone) to produce the project and future returns from it. Hence, the only remaining question is how to trade off returns in the future with the loss of present consumption needed to attain one future or another. This literature is very important and sophisticated, but since futures and foresight studies have not made any fundamental contributions to this literature, we pass over it here.

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38 Figure 2 has other features such as the location of uncertainty which affects how it is treated, and its fundamental nature which can be epistemic uncertainty (due to limitations in our current knowledge but perhaps eventually knowable) or variability uncertainty (due to intrinsic factors such as the possibility the timing of earthquakes might never be predictable or that weather may never be predictable farther out than two weeks because of chaos theory). N.V. Kornovskii, V.S. Zakharov, and A.A. Naimark, 2021, “The Unpredictability of Strong Earthquakes: New Understanding and Solution of the Problem, Moscow University Geology Bulletin, 76:4, 366-373. “…reliable and accurate prediction of strong earthquakes cannot be possible.” Paul Voosen, 2019, “How Far Out Can we Forecast the Weather: Scientists Have a New Answer, Modern Models Reveal an Upper Limit of Two Weeks,” *Science*.


40 California 100 and School of International Futures, “Beyond Strategic Planning: A Foresight Toolkit for Decision Makers,” https://california100.org/toolkits/

A second literature takes a broader look at what we owe future generations, and it has been shaped by considering the possibility of climate change, the kind of future that it will produce, and the obligations, if any, that current generations have to future ones. This literature considers multi-dimensional descriptions of the future, what future generations will care about, and how we might ascertain their preferences. Economists have contributed to this discussion with methods such as the development of generational accounts that show how future generations are affected by the federal budget, but others who are concerned with future generations have made contributions as well.

A third literature has come principally from two scholars, one a political scientist and the other a sociologist, who developed normative typologies for thinking about the future. Harold Lasswell, a political scientist (1902-1978), was a founder of the field of public policy dating back to his seminal definition of politics in 1936 as “Who Gets What, When, and How?” and his proposal for the policy sciences in 1951. Wendell Bell, a sociologist (1924-2019) who worked with him at Yale on the Yale Collegium, recounts in his 1997 two-volume work on futures studies how Lasswell supported and advanced futures studies as well. Bell describes an influential memorandum Lasswell wrote while at Yale in the 1960s that described five steps for policy analysis, reminiscent of the Bishop-Hines futures foresight framework for futures studies. These five steps were “the clarification of goals and values, the description of trends, the explanation of conditions, the projection of possible and probable futures if current policies are continued, and the invention, evaluation, and selection of policy alternatives (in order to achieve preferred goals).”

More germane to the study of preferences, Lasswell developed a list of eight broad values whose allocation must be considered in the study of politics and public policy: (1) wealth, (2) well-being, (3) skill, (4) enlightenment, (5) respect, (6) affection, (7) rectitude, and (8) power. Most importantly, Lasswell related these values to stratification systems and the allocation of

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Economic Advisers Issue Brief, January 2017, “Discounting for Public Policy,”


46 Ibid., Volume 1, pages 49-50. A similar list is in Harold D. Lasswell, “Strategies of Inquiry: The Rational Use of Observation,” page 107 in Daniel Lerner (editor), 1959, The Human Meaning of the Social Sciences, Cleveland: Meridian Books. Lasswell also proposes the development of the “social planetarium” in this article that--just as the astronomical planetarium seamlessly shows the past, present, and potential future course of the heavens--shows the past, present, and potential future of society.

value within a society in what he called configurative analysis.48 He noted that some people inevitably obtain more of these things than others—leading to inequality. He called the first four of these “welfare values” that determined who obtained the goods and services from an economy. They are connected, respectively, to the stratification of monetary rewards (wealth), health and safety (well-being), occupations (skill), and education (enlightenment) within the economy. In Weber’s famous triad of “Class, Status, and Party,” these welfare values are about “class.”49 The last four “deference values” depend upon some people deferring to others. The first three determine the stratification of prestige (respect), popularity (affection), and honor (rectitude) within the society based upon what individuals think of others—what Weber would call “status.” The final value determines the stratification of power within the polity based upon who controls the legitimate use of authority within it—what Weber calls “party.”

By linking values to stratification systems, Lasswell brought fairness, justice, and equity to the foreground, and he provided a “meta-systems” framework for thinking about the organization of societies. His method of configurative analysis considers scenarios about different ways that value might be distributed so as to determine, in his famous formulation, “who gets what, when, how?” These scenarios lead to fundamental questions and conundrums about how inequality in these systems facilitates or impedes the operation of a society. Can societies prosper when inequalities in the allocation of welfare values seem necessary to provide adequate incentives and rewards for people to produce goods and services, and yet these inequalities also create resentments and revolutions? Can societies thrive when deference seems either inevitable given the human predilection for group affiliations and comparisons or necessary given the need for hierarchies to get things done, and yet only some can be most respected, popular, honored, or powerful, leading to more resentments?

In the second volume of his two-volume work, Bell builds upon Lasswell’s values by relating them to other lists.50 Bell and Lasswell’s work provide a very broad checklist of values to be considered that goes beyond the usual discussions of values.51 Most importantly, the focus on values by these futures studies scholars spotlights stratification systems and their functional and dysfunctional features—a rare focus in policy studies which often take these systems as unalterable givens. With these concerns about values and the tool of configurative analysis, those thinking about the future can consider the consequences of alternative stratification systems based upon one set of values rather than another so that values plainly enter into the daily operations and practices of these societies.

48 An early version of this schema is in Harold Lasswell, 1936, op. cit. The fully formed approach is in Lasswell and Kaplan, 1950, op. cit., Chapters IV and V.
50 Ibid., Volume 2, “Values, Objectivity, and the Good Society”.
51 Some public policy scholars have also broadened the discussion of values. Among policy analysts the scholar who has gone the farthest is Stone, 2012, op. cit.
Combining Futures Studies and Public Policy Analysis

Although policy analysis and future studies are different, they have many points of contact and similarities. Not surprisingly, scholars have repeatedly seen them as complements to one another. As noted above, at least one scholar, Harold D. Lasswell, was both a founder of policy studies and of futures studies who thought that future studies should be an integral part of public policy studies.52

Other influential figures who have written extensively about policy analysis also recognize a need for taking future scenarios into consideration. As program chair for the 2002 annual conference of the Association for Public Policy Analysis and Management, Eugene Bardach proposed that policy scholars should not only be applied social researchers who study “What Is?” questions about the past and present, but they should also be able to speculate about “What If...’ questions about the possible effects of various policy options on outcomes.”53

William Dunn’s widely used textbook on public policy analysis devotes a chapter to “Forecasting Expected Policy Outcomes,” and he introduces futures methods (“Types of Futures” and “Judgmental Forecasting”) as well as statistical methods.54 One recent attempt that offers a fresh and integrative perspective on policy analysis is Peter Linquiti’s “Rebooting Policy Analysis: Strengthening the Foundation, Expanding the Scope.”55 He dedicates a section to “using policy analysis to visualize the future,” and he presents methods such as Monte Carlo modeling, systems dynamics, and scenario analysis to understand likely outcomes.

A noteworthy attempt at applying a common futures technique to public policy was made by Ringland Gill in her book Scenarios in Public Policy.56 Gill shows how scenarios can be used to think about uncertainty in a structured way. Gill’s steps for developing scenarios include identifying focal issues and key forces and drivers in the local environment, ranking these forces by uncertainty and importance, fleshing out the alternative scenarios, and discussing and analyzing strategic options.

Although it does not directly refer to either future foresight or public policy analysis, Ralph Keeney’s Value Focused Thinking 57 is a fundamental contribution that shows how decision-analysis (think “policy analysis”) should pivot from focusing on problems and decisions to focusing on alternatives and values (think “future foresight”). Keeney’s concept of Value-Focused Thinking (VFT) puts values at the center of decision-making. Having explicit values makes it easier to rank existing alternatives, generate new alternatives, communicate, and negotiate, and identify new decision opportunities to pursue. He discusses ways of identifying and measuring objectives (of a decision situation), assessing the achievement of these

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54 Dunn, 2018, op. cit.
objectives, and quantifying them with a value model. He also gives concrete suggestions for creating alternatives and identifying decision opportunities that go beyond solving the problem at hand. Stating preferences and values in this manner helps us understand what aspects of the future we care about and lays the groundwork for further exploration.

There is a strong intellectual case for adding futures studies to the public policy curriculum because it can broaden our perspectives, stimulate our imaginations, introduce a range of values, and identify challenges and opportunities that might otherwise be missed. It can also stimulate us to decide what kind of future we want to have and to construct a path there instead of focusing on incremental problem solving. Moreover, the works of Bardach, Dunn, Gill, and Linquiti suggest that policy analysts increasingly recognize future foresight as a complementary and informative endeavor.

Nevertheless, traditional policy analysis should probably continue to be the starting place for public policy education because students need to learn how to define and solve simple problems before they can be let loose to construct the future. And there remains the practical question of what exactly future foresight has to offer beyond a greater focus on the future. In truth, futures studies has been a fuzzy field for many years, but it is becoming more and more structured and disciplined as we shall show. After describing methodological frameworks for futures studies that can serve to facilitate instruction and to bring a structured research agenda to the field, we shall show that the experience of California 100, a several year futures-oriented project on what lies ahead for California, demonstrates the utility of a futures perspective.

Frameworks for Futures Studies

The Expected Utility Framework

Decision analysis using expected utility, as in the simple decision problem in Figure 3, provides a powerful framework for thinking about the future when there is only statistical uncertainty. In Figure 3, a decision-maker or analyst is thinking about policy actions that might be taken to ameliorate the impacts of climate change. To make things simple, only two levels of climate change are possible—a 1 degree increase in temperature or a 2 degree increase. In addition, there are just two possible actions—investing in renewables or maintaining the status quo. We shall not work our way through the (actually very simple) mathematics here. Instead we will use it as a way to understand what we would ideally like to know about the future.
Decision analysis and expected utility theory break down a decision problem into the four pieces listed in Figure 4 that are also listed at the top of Figure 3. Actions are things that we can do such as enacting public policies to invest in renewables. Outcomes are the results of actions and all the exogenous forces operating in the world such as the extent of global warming. Probabilities are the chances that some outcome will occur given different actions. These probabilities reflect the causal relationships extant in the world. Finally, values or utilities represent the decision-maker’s preferences for different outcomes expressed numerically with higher numbers indicating greater preference. Two of these (actions and
values) in purple on the figures are under the control of the decision-maker, and two of them (outcomes and probabilities) in red have to do with the outside world.

**Figure 4 – The Elements of a Decision Analysis Problem**

- **Actions** – Things that can be done such as public policies
- **Outcomes** – Results of actions and exogenous forces
- **Probabilities** – Chances of outcomes given actions. These chances reflect the causal relationships that exist in the world between actions and outcomes
- **Value or Utility** – Numerical representations of people’s preferences for various outcomes

*Source: Authors*

The decision-analysis approach assumes that everything about the problem can be put in the form of the decision tree in Figure 3 and that the various aspects of the problem listed in Figure 4 can be completely described and quantified. Here are some of the assumptions that the method makes:

- **Future Describable:** *Description of the Future Fully Contained in Outcomes* – The description of the four possible futures is assumed to be completely contained in the four outcomes and their descriptions. Needless to say, this amounts to a very “bare” description of the future. Futures studies and policy analysis often struggle with the possibility that actions may have unintended and unanticipated consequences that should have been considered, but were not imagined so that a more extensive description of the future would be useful.

- **Preferences Explicable:** *Goals and Objectives can be Enumerated and Evaluated* – Decision theory makes two assumptions in order to evaluate alternative actions:
  - **Preferences Specified:** *All Relevant Goals and Objectives Can be Specified* – Parallel to but distinct from the problem of completely specifying outcomes is the problem of fully specifying the relevant goals and objectives. The difficulties here include not knowing what is really wanted, not knowing whom to consult about preferences, and finding (as with future generations) that goals and objectives change.
  - **Preferences Measurable:** *Goals Measurable as Costs and Benefits in Common Metric* – Not only can outcomes and objectives be fully specified for the problem, they can be linked so that outcomes can be assessed in terms of how
much they do or do not contribute to each objective. Ideally the degree to which the goals and objectives can be achieved in each outcome can be described in a common metric such as money or utility. In practical terms this task is very complicated.

- **Causal Mechanisms and Probabilities of System Producing Outcomes Known:**
  - Probabilities Capture the Causal Impacts of Actions on Outcomes – It is assumed that the two probabilities fully capture the causal processes that lead to the various outcomes. Behind this assumption are two others:
    - **Known Causal Mechanisms:** Causal Processes from Actions to Outcomes Understood – Typically this assumption means that the causal processes can be specified so that enough is known to intervene in them to produce the desired result. This means that the researcher knows the relevant variables and factors and that their relationships are understood. For example, it is assumed that if the action is meant to restore the ozone layer, then the causes of its disappearance are understood in enough detail so that an action can be taken to restore it.
    - **Known Probabilities:** Probabilities can be Assigned to these Causal Processes – One way to sidestep these issues is to find experts and to elicit from them subjective probabilities about the degree to which, for example, banning chlorofluorocarbons, will solve the ozone layer depletion problem. This approach is often used in analyses of risks from chemicals to the environment and on people.58 Another approach is to develop predictive models such as Integrated Assessment Models (IAM) that combine meteorological and economic models to assess the impacts of policies on climate change.59

- **All Actions Known:** Possible Actions Fully Described by Actions in the Decision Tree – The feasible actions are those described in the decision problem. In this case these are either the “status quo” or investing in renewables, and it is assumed that no other actions need to be considered. Constructivists would argue that there are typically many, many options for any problem, and new actions might be conceived that would be better than the ones that initially present themselves. For example, in the climate example, carbon sequestration, stratospheric aerosol injection, solar engineering with moon dust, and many other options are possible.

- **Decision Rule Clear-Cut:** Decision Rule Determined by Some Mathematical Expression such as Expected Value or Expected Utility – Expected value just requires a simple

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calculation. Most textbooks go one step farther and suggest assigning utilities to outcomes, and they often discuss at some length the possibility that a decision-maker might be risk averse so that options with the same expected values should be treated differently if they have different variances. Some textbooks also discuss decision rules such as minimax-regret that can be used if probabilities cannot be assigned, but by-and-large the decision rules do not take into account the degree to which problems are incompletely defined, deal with deep uncertainty, and might encounter options in the future that cannot even be imagined today.

These are very substantial assumptions. Textbooks tell students how they can be relaxed to some degree, but the standard textbook urges the student to move toward the precision of the decision theory format.60 Futures thinking has gone in the opposite direction by trying to figure out how to proceed when only pieces of knowledge and preferences are available. The major frameworks are discussed in the next three sections.

The Statistical Forecasting Framework

The statistical forecasting approach focuses on predicting the future course of just a few variables (often only one) that provide a very sparse, but statistically grounded, picture of future outcomes. Typical variables include the interest rate, population size, energy reserves, tax revenues, housing production, or average climate temperature. The method works best when there is ample historical data on the variable that can be mined, when the outcome variable is determined by a relatively small number of factors for which data are available (such as fertility rates, death rates, and immigration for the study of population), when the relationships among these variables are well-understood, and when past patterns do not suddenly shift or change.

For the method to be useful for decision-making, it also usually requires a “policy” variable—such as the federal funds rate or tax rate—strongly causally related to the outcome that can control outcomes because of its strong causal connection. An overall framework that often guides this approach is “optimal control theory” developed to model physical systems such as airplane flight whose physical equations of motion can be described by physics and whose flight-path can be affected by the manipulation of physical controls such as wing surfaces and thrust.61

The framework is powerful, but social systems usually cannot be described as accurately as the equations of motion that govern an airplane’s flight, and good control variables are hard to find as central banks have realized when they have tried to control inflation and unemployment.62

Forecasters use econometric methods to try to estimate the “equations of motion” of social systems. Mary Morgan, who has written a definitive history of the development of these

methods, finds their sources in statistics, the analysis of sunspot cycles and business cycles, trend analysis, and efforts to study supply and demand. Major developments along the way were the illustration of omitted variable bias in Yule’s late nineteenth century work on pauperism, the recognition of spurious correlations in trending time series by Yule in the early part of the twentieth century, the efforts to write-down and estimate equations for the macro-economy by Tinbergen and Klein, and the recognition of simultaneity and identification problems in the analysis of supply and demand, especially in the work of the Cowles Commission in the early 1950s. Perhaps the high-point of optimism about these developments was the creation of the Brookings Model of the Economy in the 1960s with the hope that it would marry theory and econometric estimation to produce successful economic forecasts about all aspects of the economy. The Brookings Model failed, and economists spent the next thirty years trying to understand what went wrong.

An important step was the 1976 critique by Robert Lucas that emphasized the problem of rational expectations in which rational actors change their behavior (and thus the parameters of a model) under conditions such as rising inflation. In the past 50 years econometrics has evolved to deal better with rational expectations, endogeneity, co-integrated time series, identification problems, selection problems, omitted variables, and a myriad of other difficulties now covered in basic texts. A recent 167 page, 80 author review article in the *International Journal of Forecasting* on “Forecasting: theory and practice” presents a vast number of methods now used including VAR (vector autoregression), ARIMA (auto-regressive integrated moving average) models, Kalman Filters, Bayesian forecasting, machine learning, ARCH/GARCH models, exponential smoothing, prediction markets, Delphi, and many others. Perhaps the biggest lesson of the past 50 years has been the realization that most time series are not stationary so that they require special methods to avoid forecast error. Related to this is the realization that “structural shifts” are ubiquitous and must be incorporated in forecasting models. Hence, the method can even fail when a single variable is the focus.

When they are available, forecasting models should certainly be used, but they often provide a one-dimensional picture of the future and they often miss important structural changes that radically affect outcomes.

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The Scenarios Framework

While the statistical forecasting method tries to predict and alter the future of some variables much like a pilot of an airplane uses the controls to determine a flight path, the scenarios framework tries to imagine possible futures in colorful detail more like a dramatist putting on a play. And just as a play can cause audiences to reflect on how a tragedy could be averted or a comedy could be realized, the goal of scenario construction is to activate the imagination so that decision-makers can avoid tragedy and bring about an acceptable outcome by constructing a path to a satisfactory future.

The approach is as old as utopian and dystopian thinking that goes back to Plato’s Republic (375 BC). Some examples of the genre between then and 1950 include Thomas More’s Utopia (1516), Francis Bacon’s New Atlantis (1627), Margaret Cavendish’s A Blazing World (1666), Jonathan Swift’s Gulliver’s Travels (1726), Samuel Butler’s Erewhon (1872), Edward Bellamy’s Looking Backward (1888), William Morris’s News from Nowhere (1890), H.G. Wells, A Modern Utopia (1905), E.M. Forster The Machine Stops (1909), Karel Capek’s R.U.R.—Rossum’s Universal Robots (1920), Aldous Huxley’s Brave New World (1932), and George Orwell’s 1984 (1949). Most of these books invented futures where new forms of social relations figure more prominently than technological developments, but some such as The Machine Stops and RUR highlight inventions presaging the Internet or robots with artificial intelligence, respectively. It is not surprising that an early contribution to futures studies (1955) by Frederick Polak on “The Image” of the future began with an extensive review of the utopian literature.  

The analytical use of scenarios can be traced back to Harold D. Lasswell’s idea of “developmental constructs” as embodied in his 1941 article on “The Garrison State.” This article described the rise of states that would rely on the “supremacy of the specialist on violence, the soldier.” Lasswell used his theory of value allocation described earlier (“the configurative method”) to paint a vivid picture of the social structure of this new kind of society. Although in 1941 this scenario seemed quite possible in Germany, Italy, Japan, Russia, and even the United States, Lasswell was wrong in thinking that the Garrison State would prevail, but his article provoked a long-running discussion about possible future societies. Moreover, he was certainly right in thinking that countries such as the United States would from 1941 onwards have a large and powerful defense sector.

Lasswell’s configurative method was based upon an explicit combining of what he called the “contemplative standpoint” that studied facts and causal relations and the “manipulative standpoint” that begins with goals and “courses of action leading to the goal.” This approach was in “the philosophical tradition in which politics and ethics have always been closely associated.” Philosophically, Lasswell was squarely in the American pragmatist tradition of Peirce, James, and Dewey, and even though he used quantitative methods, he mostly eschewed...
the logical positivism that was an important force in American social science throughout the twentieth century. In their 1950 book, Lasswell and Kaplan approvingly cite John Dewey:

“Historians should be engaged in construing the past in terms of the problems and interests of an impending future, instead of reporting a past in order to discover some mathematical curve which future events are bound to describe.”

One imagines that Lasswell would be quite comfortable with modern constructivist approaches as long as they recognized the stubborn reality of many facts, norms, and causal relationships.

In the 1960s, the use of narrative scenarios blossomed in two places – defense planning and business planning. Herman Kahn, a leading thinker at RAND, wrote *On Thermonuclear War* (1960), *Thinking about the Unthinkable* (1962), and *The Year 2000: A Framework for Speculation on the Next Thirty-Three Years* (1967) which made extensive use of scenarios. A group at Royal Dutch Shell started using scenarios in the 1960s. Their work predicted the possibility of a discontinuity in trends of more and more energy production in reaction to world demand. When the discontinuity occurred in the form of the OPEC oil cartels 1973 embargo, Shell was better prepared than other energy companies. Books by members of the Shell team provided impetus and guidance for businesses to use scenario thinking. Today, scenarios are the most widely used futures method. They employ a wide variety of methods, and they take many different forms. Peter Scoblic has argued that their narrative form accords better with human information processing than statistical methods.

### The XPROW-XLRM Framework

Figure 5, adapted from a recent compendium of articles about decision-making under deep uncertainty, presents a general and abstract framework that encompasses the preceding frameworks: the decision-analysis example in Figure 3, the decision-analysis elements in Figure 4 that assume statistical uncertainty, the statistical forecasting framework, the scenarios approach, and situations where there is scenario or recognized ignorance (deep uncertainty) as described in Figure 2. Figure 5 combines work by Lempert and his colleagues to develop the XLRM (eXogenous uncertainties, Levers, Relationships, Measures) framework and by Walker and others to develop the XPROW (eXogenous forces, Policies, Relationships, Outcomes).

75 Ibid., page xii, footnote 5. Also see William Dunn, 2019, *Pragmatism and the origins of the policy sciences: rediscovering Lasswell and the Chicago School*, Cambridge.
81 Marchau et al., op. cit. Chapter 1.
Weights) framework. These two frameworks are essentially the same. Our adaptation compares XLRM and XPROW with the expected utility approach.

**Figure 5 – Framework for Thinking about the Future**

The empirical core of the model—composed of external forces, the system describing the decision domain, and outcomes—is enclosed in the partial red oval in the middle of the figure. The normative and constructivist aspects of the model are in the purple rectangle in the upper right-hand corner. The normative, decision-making aspects consist of the decision-maker, goals and objectives, and stakeholders. The constructivist aspect consists of the policies or strategies that can be used to construct the future.

*External forces* include the economy, the environment, demographics, future decision-makers, and a host of other factors. The *system* is described by some model such as an Integrated Assessment model for climate change, a housing and transportation model for urban planning, the configurative approach of Lasswell, or some qualitative model. *Outcomes* are the possible results from each action such as the impacts on economic well-being, global warming, commute times, or housing costs of various policy actions. Putting these concepts

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83 The figure is based upon Figure 1 on page 13 in: Warren E. Walker. 2000. Policy analysis: A systematic approach to supporting policymaking in the public sector. *Journal of Multicriteria Decision Analysis*, 9(1–3), 11–27. Walker does not use the acronym “XPROW” in that article.

84 Metcalf and Stock, 2017, op. cit.

together provides an empirical understanding of the world that is being considered. In terms of our earlier simple decision model, they are a substantial elaboration of the probabilities in that model—they provide information on the causal relationships that underlie those probabilities.

Policies are the strategies employed to construct alternative worlds with better or worse outcomes. Decision-makers, goals, and stakeholders provide an assessment of whether alternative worlds are, in fact, better or worse than the status quo. They choose the policies that provide the best outcomes.

Marchau, Walker, Bloemen, and Popper, the source of Figure 5, have provided the most complete review of DMDU methods for Decision Making Under Deep Uncertainty, and they have been leaders in the DMDU Society. In their book, they present Figure 6 which depicts the relationships between the XPROW framework and various levels of uncertainty. The elements of the XPROW framework are listed on the left. Policies (P) do not appear because they are instruments that are chosen so that there is no intrinsic uncertainty in them as there is in the context (X), system model (R), system outcomes (O), and weights (W) which are listed. The three levels of uncertainty on Figure 2 above (statistical, scenario, and recognized ignorance—deep uncertainty) roughly correspond with some of the “levels” on Figure 6 below as indicated by our annotations in red across the top of the figure.

Figure 6 shows that there are many public policy problems with scenario or deep uncertainty that are not amenable to standard methods such as deterministic modeling (the first two columns of “complete determinism” or “little to no uncertainty”) or expected utility theory (the third column of “statistical uncertainty”). Although “Complete Determinism” probably doesn’t exist in any situation and “Level 1, Little or No Uncertainty” refers to routine events such as garbage collection or mail delivery, these are situations where a deterministic system model might be sufficient for most circumstances except where exceptional events such as storms or earthquakes disrupt the system. As discussed earlier when we presented the Uncertainty Matrix in Figure 2, Level 2 on Figure 6 corresponds with “Statistical Uncertainty” where a stochastic model can be developed and sensitivity analysis can suffice to guard against variation in future events. Many economic and engineering models such as housing markets and transportation flows fit (mostly) into this category.

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86 The Pardee Center helped in the formation of the Society for Decision-Making Under Deep Uncertainty that was started in 2014 at a meeting at the RAND corporation. https://www.deepuncertainty.org/
87 Given the vagaries of politics, it might make sense to add a row that considers uncertainty in the policies that are proposed.
The next two levels of uncertainty demonstrate the need for futures thinking and futures methods. Level 3 on Figure 6 corresponds to “Scenario Uncertainty” where there are a few plausible futures, a few alternative system models, and a limited range of outcomes so that it is possible to develop a range of possibilities, even if little is known about the probability that they will occur. Models for the future of organizations or for regions often can be handled by this approach. Level 4 on Figure 6 is “Deep Uncertainty” (or recognized ignorance) where there are many plausible futures and little is known about them. The RAND Corporation has developed methods for dealing with these circumstances.88 Finally, there is “Total Ignorance” where it is hard to even imagine the future, much less produce probabilities for what outcomes are likely. This might be the situation we face with respect to climate change given the possibility of unforeseen trigger events,89 although many researchers have tried to reduce the problem to one of statistical uncertainty.

Methods for the Analysis of the Future

Once we recognize the limits of the standard decision analysis model, it becomes clear that we must develop additional methods for futures studies. These methods consist of two kinds. Meta-methods provide an overall framework. Specific methods solve problems created by the failure to satisfy the assumptions listed after the discussion of the expected utility model above.

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88 Marchau et al., 2019, op. cit.
Meta-methods include the elaboration of the Bishop-Hines steps approach in Figure 1, the expected utility paradigm in Figure 3, the statistical forecasting approach, scenarios, and the XPROW-XLRM approach in Figure 5. Although improvement is always possible, the XPROW-XLRM framework provides a good starting place for meta-methods.  

Specific methods include a potpourri developed in futures studies to address failures to meet one or more requirements of the expected utility model. These requirements, discussed earlier, are summarized in Figure 7 below. They are also closely related to, but not quite the same as, the elements of the XPROW model listed along the rows in Figure 6. Figure 6 lists the type of elements or pieces (context, system model, system outcomes, and weights) of the XPROW model, much as Figure 4 lists the type of pieces (actions, outcomes, probabilities, and utilities) of the expected utility model. Figure 7 actively poses questions about the function and completeness of these pieces with respect to the tasks required to think about the future.

**Figure 7—Requirements of the Expected Utility Framework**

<table>
<thead>
<tr>
<th>A. Future Describable:</th>
<th>Description of the Future Fully Contained in Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Preferences Explicable:</td>
<td>Goals and Objectives Can be Enumerated and Evaluated</td>
</tr>
<tr>
<td>1. Preferences Specified:</td>
<td>All Relevant Goals and Objectives can be Specified</td>
</tr>
<tr>
<td>2. Preferences Measurable:</td>
<td>Goals Measurable as Costs and Benefits in Common Metric</td>
</tr>
<tr>
<td>C. Causal Mechanisms and Probabilities of System Producing Outcomes Known:</td>
<td>Probabilities Capture the Impacts of Actions on Outcomes</td>
</tr>
<tr>
<td>1. Known Causal Mechanisms:</td>
<td>Causal Processes from Policies to Outcomes Understood</td>
</tr>
<tr>
<td>2. Known Probabilities:</td>
<td>Probabilities Can be Assigned to these Causal Processes</td>
</tr>
<tr>
<td>D. All Actions Known:</td>
<td>Possible Actions Fully Described by Actions in Decision Tree</td>
</tr>
<tr>
<td>E. Decision Rule Clear-Cut:</td>
<td>Decision Rule Determined by Some Mathematical Expression such as Expected Utility</td>
</tr>
</tbody>
</table>

Newcomers to futures studies find its methods to be a confusing jumble of various techniques—some borrowed, some new, and some odd. One reason for this is that futures researchers have been forced to improvise given the uncertainties that confront them. Another reason for this confusion is that there is no standard textbook or article that tries to categorize these methods with respect to their function. One of the few articles to consider an array of futures methods classifies them in an idiosyncratic way with respect to their use of “creativity, expertise, evidence, or interaction,” providing no sense of what fundamental problems they are trying to solve.  

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90 Lasswell’s configurative method also provides a complementary framework to these meta-methods.

utility model listed in Figure 7. By treating futures methods as ways to solve problems created by the failures of requirements for the expected utility model, it becomes clearer why each method exists, and what it is trying to do.

Two examples can give some idea of what is done in more detail in the Appendix. “System dynamics” is a relatively well-known approach because of its use in the “Limits to Growth” debate.92 Its users employ a programming language that represents social systems as interrelated nonlinear differential equations defined by the analyst. The “futures wheel” is less well-known, but it is a simple technique in which people are asked to start at the center of a wheel that identifies some event and to work outward by first indicating the first order, then the second-order, and then the higher-order implications of the event such as the invention of the Internet.

Many quantitative social science researchers look askance at “system dynamics” as a way to model phenomena because it often relies upon expert opinion to describe causal relationships instead of testing them with empirical data, and they find the “futures wheel” to be equally peculiar as it relies upon opinion as well. Both of these approaches make more sense when we recognize the difficulty of establishing causality93 which is assumption C1 on Figure 7 and the necessity in futures thinking of at least some speculation about what events might follow others. “Futures Wheels” are one device to encourage (hopefully informed) speculation.94 In areas where those involved in thinking about the future are experts on the phenomenon being considered, it seems likely that this method could generate useful results. One could imagine using this approach with experts who are considering the impacts of some new policy in order to generate hypotheses about what might happen with some policy such as banning hydrofluorocarbons to restore the ozone layer. Similarly, system dynamics might provide a good starting place, despite its faults, for thinking about the interactions and nonlinearities in a dynamic system.95 In short, some idea about what the future might bring is probably better than complete ignorance.

Some of the methodological tasks confronting futures research are to get a clearer picture of why various methods are being used, when it makes sense to use them, how they can provide replicable results, and how much they really provide useful information—that is, how they can be more scientific. The discussion in the Appendix is a first attempt at doing this. By sorting out methods in this way, it should become possible to get a better appreciation for what they can and cannot do.

92 Dennis Meadows et al., 1972, The Limits to Growth, Potomac Associates.
95 An example of a very useful systems dynamics model is the “En-Roads Climate Solutions Simulator” that looks at energy production and greenhouse gas emissions. https://en-roads.climateinteractive.org/scenario.html?v=23.6.1
California 100 Reports as a Test-Bed

The California 100 project is an ambitious effort to assess the future of California and to provide policy-makers with useful guidance about how to construct a better California. The project has many components including a Youth Summit, Deliberative Poll, Innovation Projects, and a 26-member Intergenerational Commission, but one key feature was the commissioning of 30 reports in 15 subject matter areas on the future of California. The 15 subject matter areas are listed in Table 1.

Table 1 – California 100 Policy Areas

<table>
<thead>
<tr>
<th>Infrastructure and Land Use</th>
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</thead>
<tbody>
<tr>
<td>1. Energy, Environment, and Natural Resources</td>
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<tr>
<td>2. Housing and Community Development</td>
</tr>
<tr>
<td>3. Transportation and Urban Planning</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Business and Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Advanced Technology and Basic Research</td>
</tr>
<tr>
<td>5. Agriculture and Food Systems</td>
</tr>
<tr>
<td>6. Business Climate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workforce and Education</th>
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</thead>
<tbody>
<tr>
<td>7. Economic Mobility, Workforce, and Inequality</td>
</tr>
<tr>
<td>8. Education</td>
</tr>
<tr>
<td>9. Immigration Inclusion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wellness and Safety</th>
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</thead>
<tbody>
<tr>
<td>10. Art, Culture, and Entertainment</td>
</tr>
<tr>
<td>11. Criminal Justice Reform and Public Safety</td>
</tr>
<tr>
<td>12. Health and Wellness</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Governance and Fiscal Policy</th>
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</thead>
<tbody>
<tr>
<td>13. Federalism and Foreign Policy</td>
</tr>
<tr>
<td>14. Fiscal Reform</td>
</tr>
<tr>
<td>15. Governance, Media, and Civil Society</td>
</tr>
</tbody>
</table>

The reports for the California 100 project policy areas listed in Table 1 provided a useful test bed for seeing whether policy researchers can fruitfully do research on the future and come up with ways to construct the better futures.96

For each subject matter area, the project developed two reports. The first report was a Facts-Origins-Trends (FOT) report of about 100 pages that summarized the facts, origins of those facts, and the trends in them for the policy area. In Bardach’s terms, the FOT reports answered “What is?” questions. The FOT reports engaged in familiar forms of descriptive,97

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96 Henry Brady is the Research Director for California 100. See https://california100.org/research-streams/. We thank our researchers for their tremendous contributions to these reports.

interpretive,98 and causal inference99 in order to reduce uncertainty about where we are (Facts), describe how we got to where we are (Origins), and indicate where we are going (Trends).

These FOT books provided the background against which the second report on Future Scenarios and Policies was developed for each policy area. These reports answer “What if?” questions. Each of these Future Scenarios and Policies reports of about 50 pages identified two critical future uncertainties in their subject matter area, dichotomized them, and then developed four scenarios for the future based upon the four possible combinations of outcomes of two dichotomies for two critical uncertainties. Critical uncertainties are both “uncertainties” about what will happen and “critical” ones whose resolution will have a major impact on the future course of the area. For example, national policy on immigration is a critical uncertainty for the future of California’s labor force. National policy can be dichotomized as either permissive or restrictive. When combined with another critical uncertainty such as the California public’s attitudes towards immigrants (e.g., favorable or unfavorable) there are four possible scenarios of permissive-favorable, permissive-unfavorable, restrictive-favorable, and restrictive-unfavorable. The reports also proposed policies that could lead to a preferred future scenario or ameliorate the troublesome impacts of a less preferred future.

The Future Scenarios and Policies reports do something different from the Facts-Origins-Trends reports. We propose to describe them as doing “projective inference.” Projectors create the future by relying upon two uniquely human capabilities that are related to uncertainty and preferences: the ability to make plans about the future because we can think ahead and reduce uncertainty about what the future might bring,100 and the ability to communicate using language so that we can create new tools and institutions with commonly understood and accepted purposes.101

Social science methodology has focused on descriptive inference that accurately portrays the world as it is, on interpretive approaches that explore the nature of meaning and our understandings of the world in which we live, and on causal inference that gets at the causes of social outcomes. These are powerful tools for understanding the “What is?” of the world such as facts, the social meanings holding the world together, and the counterfactual possibilities that might be created. But they are not enough.

We need to consider projective inference as well. Handbooks of methodology have ignored projective inference102—the normative evaluation of the imaginative projections into the future

102 The term is used by Nelson Goodman, 1954, Fact, Fiction, and Forecast, Cambridge: Harvard University Press. We use the term, however, in a broader fashion than Goodman who was concerned with the problem of induction. We are concerned with the problem of induction and the possibility of construction.
of new possibilities that employ the opportunities for change identified by causal inference and that start from current circumstances captured by descriptive and interpretive inferences. Interestingly, Lasswell “configurative method” was designed to do just this, but it never caught on.

Through projection, humans can contrive and construct projects that put together diverse elements to solve a problem – a Constitution for a fledgling democratic republic in 1789; a Harlem Children’s zone combining education, health, and neighborhood services; or a Global Warming Solutions Act (AB 32) in California employing market mechanisms and regulatory standards to reduce Greenhouse Gases. The problem of projective inference is evaluating the likely impact of these projects.

In the California 100 project, the projection problem first became apparent in decisions about the two critical uncertainties for each policy area. What kind of statements were these to be? Were they to be statements about facts or values? Were they to be things that might come about through the operation of trends that were already apparent or were they to be the result of conscious efforts to construct a new path for the future that diverged from the past?

Consider these two critical uncertainties for housing where each one is stated with two possible dichotomous outcomes: “There will be high/low production for housing in the future” and “Housing will be for private gain/social equity in the future.” The first statement sounds more like a future fact that is an extrapolation of existing trends, while the second sounds like a description of normative values. Yet each could be partly based upon trending facts and partly based upon constructed values. In fact, if trends are operative, then low production of housing is most likely (continuing an ongoing, disastrous trend for California) and housing for private gain is also most likely, given Californian’s attitudes toward housing and especially toward low-income housing as indicated by the state’s historic unwillingness—codified in a long-standing state Constitutional amendment—to construct public housing without a vote of the local population.103 But if California decided to construct a future with more housing – something that is going on to some extent right now in the state with new laws that make it easier to build denser developments, and if California decided to construct a future with more equity, then the state could probably do so. The crucial point is that the critical uncertainties in scenario analysis are partly due to uncertainties about how causes and trends will play out, but they are also almost invariably partly the result of our preferences. We can allow the future to happen, or we can construct the future we want—subject, of course, to some constraints.

A statement about the future then, comes fully equipped with both causal mechanisms and the value-preferences that created it. The future is both caused and constructed. But since not just anything is possible, we required our scenario writers to provide us with the following information (if possible) for each scenario:

103 In 1950, Californians voted to put a provision in the state Constitution that requires voter approval before public housing in a community. This requirement remains in effect as Article 34 of the state’s constitution.
Historical precedents – Are there past examples when California (or perhaps other places) engaged in high housing production and concerns for social equity in its provision? Indeed, California has, in the past, had high housing production, and Singapore has a model of “social housing” that subsidizes housing costs.

Trends – Are there trends that make it likely that low housing production will continue and that social equity will not be considered? The trends in California for decades has been for limits on housing production.

Signals – Are there indications, perhaps just chirps in the dark that suggest a possible change in trends? For example, have some decision-makers started to call for the end of large lot zoning, the creation of incentives for high-density, or support for manufactured housing?

Our researchers, who were accustomed to doing what Eugene Bardach calls “What is?” research, found it to be a stretch to do “What if?” research, but in every case, they succeeded in producing exceptionally thoughtful and persuasive critical uncertainties, scenarios, historical precedents, trends, and signals. We believe that the result is a treasure trove of ideas of what California’s future might be like, how we can deal with it, and how we can shape it to make it better.

The scenarios produced by California 100 are more credible because they cite historical precedents, trends, and signals, but they are just a beginning. We need a better set of guidelines for projective inference that tell us when something might not be possible or might not make sense. We need ideas just as powerful as omitted variable bias, selection bias, simultaneity bias, etc. to refine our projections. Models sometimes provide one way to find flaws in our analysis because we cannot create the future we want to construct in the model, but we need more methods than modeling.

The Case for Futures and Foresight Studies

The futures literature, decision theory, and policy analysis have interacted and borrowed from one another for the past 60 years. They all had intense periods of development from roughly 1960 to 1990. Policy analysis has been ensconced in public policy schools at major universities. Decision theory is a staple of the business curriculum. Both public policy analysis and decision theory are rooted in incrementalism and formalization. Incrementalism precluded “big thoughts” about the future. Formalization provided a veneer (and probably the reality) of objectivity and scientific method, but it too limited the reach of public policy analysis. Futures studies has had a more complicated history with a period of neglect, even derision, for the past 30 years. Yet it kept alive a broader approach to thinking about the future.

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104 California 100 worked closely with its research partners in these efforts, and it had the benefit of experts from the Institute for the Future who helped the researchers by reviewing their work and making suggestions for improvements. For the final reports, see https://california100.org/research-streams/
As summarized in Table 2, policy analysis and futures and foresight studies have different characteristics that make them complements to one another. The chart caricatures each approach in order to provide vivid contracts. The preceding discussion has tried to temper this stereotyping although it has also provided reasons why the entries make sense. Moreover, the goal is not to force a choice between the methods, but rather to develop a synthesis that will strengthen them.

**Table 2 – Comparison of Characteristics of Policy Analysis with Futures and Foresight Studies**

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>POLICY ANALYSIS</th>
<th>FUTURES AND FORESIGHT STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Orientation</td>
<td>Solving Problems</td>
<td>Values and Futures Exploration</td>
</tr>
<tr>
<td>Temporal Focus</td>
<td>Present and Short-term</td>
<td>Future and Long-term</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>Deterministic or Statistical Uncertainty</td>
<td>Scenario or Deep Uncertainty</td>
</tr>
<tr>
<td>Focus on Which Alternatives?</td>
<td>Alternative Policies</td>
<td>Alternative Futures</td>
</tr>
<tr>
<td>Focus on What Values?</td>
<td>Efficiency, Effectiveness</td>
<td>Broader Structural Values</td>
</tr>
<tr>
<td>Clients</td>
<td>Officials and Organizations</td>
<td>Future Generations and the Public</td>
</tr>
<tr>
<td>Decision Rules</td>
<td>Maximize Utility, Benefit-Cost</td>
<td>Robust, Resilient, Modifiable</td>
</tr>
</tbody>
</table>

Policy analysis is oriented toward solving problems in the present and the short-term where there is not a great deal of uncertainty. Futures and foresight analysis is oriented toward exploring values and possible futures embodying those values in the long-term where there is typically substantial, often deep, uncertainty. Policy analysis focuses on alternative policies
and their efficiency and effectiveness while futures studies focuses on alternative futures and the degree to which they embody values such as justice, well-being, enlightenment, and ecosystem stability. Finally, policy analysis is centered around clients and maximizing their benefit-cost while futures studies is concerned with future generations and robust, resilient, and modifiable decision rules that adapt to changing conditions and values.

Despite these paradigmatic differences between policy analysis and futures studies, both policy analysis and decision theory are increasingly concerned about values and future possibilities as a starting place for their efforts. The publication of Ralph Keeney’s book on “Value Focused Thinking” in 1992 was a turning point that validated the futurist’s emphasis on thinking about the future. And the onset of problems such as global warming, COVID-19, terrorism, water shortages, and ecological fragility have been catalysts sparking us to think about what we want the future to be. In short, the intellectual case for futures studies is strong.

The practical case is also strong. Governments and non-profit organizations recognize the need for futures studies. In 1995, the United Kingdom began publishing foresight reports, and the Government Office for Science Foresight is now located in the Office for Science. In 1997 the US National Intelligence agencies produced their first global trends report that has been followed by reports every four years. The 38 country Organization for Economic Cooperation and Development (OECD) created a strategic foresight unit in 2013 that has produced numerous reports. In 2013, the U.S. Federal Foresight Community of Interest was established as a cross-agency support network for foresight thinking. In 2018, the U.S. Government Accountability Office created the Center for Strategic Foresight “to serve as the agency’s principal hub for identifying, monitoring, and analyzing emerging issues facing policymakers,” and in 2019, it created the Science, Technology Assessment, and Analytics Team.

In 2008 California created the Strategic Growth Council supported by California’s cap-and-trade program. It makes strategic decisions to support energy efficient programs and reductions in green-house gases. In October 2021, the non-profit Public Policy Institute of California created a post of vice president and senior fellow for “Understanding California’s Future.”

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109 https://www.ffcoi.org/; The group sponsors webinars and produces a newsletter.
111 https://www.gao.gov/about/careers/our-teams/STAA
112 https://sgc.ca.gov/
The California 100 program was created in 2021. At least five other states (Arizona, Florida, Ohio, Texas, and Washington) have produced strategic foresight plans.

The work of these groups makes it clear that we can’t always have definitive models for thinking about the future. Sometimes we have to make due with large pieces of the puzzle missing. We do not fully know what outcomes are possible, we cannot clearly state our preferences (partly because they are the preferences of future generations), we cannot fully describe causal relationships or obtain the probabilities of events, and we can’t know all the policy alternatives that are possible. Nevertheless, we can develop better methods for doing these things, and we can improve upon our teaching by including these methods in our curriculums.

Indeed, we must develop methods for dealing with and teaching about the future so that we can solve the existential problems before us – just as the members of the American Constitutional Convention used the best available methods for thinking about the future to write a new Constitution for the United States.

An Agenda for Futures’ Research

Using scenario building as used in the California 100 project as an exemplar of futures studies’ methods, here are some of the issues that must be confronted to improve futures methodology:

- **Exactly How Should We Think about Statements of Critical Uncertainties?** – Critical uncertainties are neither causal assertions nor normative statements. What are they? Would experts in the logic of language be able to help us? Can we say more about what they should be and what form they should take?

- **Adequacy of Critical Uncertainties** – Are two dimensions enough to capture most of the uncertainty in a given policy area? When is this true and when is it not true? This question, it seems, is related to questions about how we can approximate the future. One useful line of attack might be to draw upon the literature in artificial intelligence relating to the surprising success of “deep learning.” What does it tell us about the number of dimensions we need to “fit” the future?

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115 Deep learning has succeeded at difficult pattern recognition tasks such as speech and image recognition, natural language processing, and bioinformatics. It is a variant of the canonical feed-forward neural network, which involves multilayer classifiers that use stacks of logistic or similar regressions where the inputs are features of the items that are to be classified. We have known for over 25 years that systems with at least one hidden layer are universal approximators that can, with relatively arbitrary activation functions, approximate to any degree nonlinear continuous functions as long as there are enough neurons (hidden independent variables) in the model. But why does deep learning work with a total number of weights and variables that seems far short of what would be necessary to approximate all of the possible curves? Why do models with many
Quality of Critical Uncertainties – Can we use anything beyond expert judgment to ascertain the quality of critical uncertainties? Does it help to use multiple experts? Could AI mining of texts help us to identify uncertainties and their frequency in the extant written texts such as newspapers or books?

Representativeness of Scenarios – Scenarios represent a sampling from a universe of possible worlds, how do we determine whether we have an adequate sample? What kind of standards should we use? Would it be useful to compare the scenarios with historical events within a given unit (for California 100, this would be California) or with events across multiple similar units (other states, other nations) to see if they cover a broad enough range of possibilities? How can we do this? Is it useful to have multiple scenarios regarding different policy areas as with the California 100 project? How can we combine these different scenarios to get maximum representation and verisimilitude?

Constructing Scenarios – How can we improve scenarios about the future? The “intuitive logics” approach depends upon people immersing themselves in the details of a situation (e.g., the Facts-Origins-Trends books of the California 100 project) and then identifying critical uncertainties. The “probabilistic modified trends school” combines statistical forecasting and subjective statistical judgments to identify plausible combinations of variables producing a plausible scenario. Lasswell used another method that looked at configurations of value allocations as a way to produce different kinds of scenarios. Lasswell’s approach seems promising because he links values, stratification systems, and social trends, but little has been done to advance it.

Possibility and Realism of Scenarios – Scenarios describe destinations in the future. We get there partly by piggy-backing on routes already laid out (as extensions of causal mechanisms and value-decisions already in place) and partly by building new routes (by constructing new tools and institutions). Some destinations may not be reachable within the stipulated time period through any combination of these two approaches. How do we know which ones are reachable? We might say that a destination that is reachable is possible given what we know. One that has a high probability of occurring is realistic. How do we identify possible and realistic scenarios?

What Do We Want Scenarios to Do? – Here there is a growing literature as researchers have looked at the impact of scenarios on decision-makers. Presumably we want
decision-makers to develop strategic plans based upon knowledge gained from scenarios, but exactly what do we want to happen and what does happen?

■ **Who Should the Decision-Makers Be?** – How do we “include” future generations in our deliberations? Should we start by including more young people? Is that enough?

■ **What Should Decision Makers Think About?** – Can we, with the help of political theorists, get a better handle on what decision-makers should think about in terms of normative values and the effort that should be put into creating new worlds that embody these values? What amount of new “road-building” should we expect in a plan for the future? Should we try to rely upon the infrastructure of institutions, practices, and physical capital that we already have, or should we be willing to develop new infrastructure? (The plans to deal with global warming are instructive because of the enormous amounts of new infrastructure that they require.)

These questions provide a starting place for more reflection on futures’ studies. They also cause us to think about the extraordinary feat pulled off the American Constitutional Convention. The audacity of the delegates is impressive, and their ability to find a way to succeed is astonishing. We should be instructed by their success to be bolder and more imaginative in our thinking.
Appendix – How Futures Methods Address the Lack of Knowledge about the Future

The Future is Hard to Describe

As in all areas, futures studies has taken an eclectic approach to describing possible futures ranging from using science fiction to morphological analysis. The use of science fiction is controversial with one author asking “Is SF [Science Fiction] of profound importance to FS [Futures Studies] or does it detract by tainting FS with pulp image?”  

A more respectable image comes from a thoughtful literature developing a “multi-level perspective for socio-technical systems” that draws from historical changes in technology. This extensive literature expands upon the classic “S” curve of the evolution of innovations by trying to explain why some innovations prosper and others fail. Innovations that are not yet viable in the larger society develop in “innovation niches” that provide supportive conditions for their growth because of government subsidies, special markets, or ardent entrepreneurs. An example would be transistors and integrated circuits which the military and space programs supported at high initial prices because of their importance for their missions. If these innovations persist and become cheaper, more widely useful, or simply attractive to customers, they take off in a “S” curve.

This literature also provides a macro perspective on the impacts of technology by describing the technological revolutions brought about by water power, steam power, petroleum and electrical power, and most recently by changes in the transmission of information through digital methods and its processing through computers. A more micro endeavor is “technological roadmapping” that tries to identify all technologies relevant to a company or a research area and their trajectory in order to predict what comes next. Text mining, patent analysis, and other methods are often used to provide an empirical basis for predictions.

Other, quite different, approaches to predicting the future are relevance trees and morphological analysis. Relevance trees look much like an organization chart, and they divide a broad topic into increasingly smaller subtopics to show all possible consequences, all possible

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120 Karollay Giuliani de Oliveira Valério, Carlos Eduardo Sanches da Silva & Sandra Miranda Neves (2021) Overview on the technology roadmapping (TRM) literature: gaps and perspectives, Technology Analysis & Strategic Management, 33:1, 58-69,
121 Chiehyeon Lim, Gi-Hyoug Cho, and Jeongseob Kim, 2021, “Understanding the Linkages of Smart-City Technologies and Applications: Key Lessons from a Text Mining Approach and Call for Future Research,” Technological Forecasting and Social Change, 170; Hao Zhang, Tugrul Daim, and Yunqiu (Peggy) Zhang, 2021, Integrating patent analysis into technology roadmapping: A latent dirichlet allocation based technology assessment and roadmapping in the field of Blockchain, Technological Forecasting and Social Change, Volume 167, June.
causal processes, or all possible policies that might be taken. For example, a 1976 study of federal government stockpiling by the Congressional Office of Technology Assessment\textsuperscript{122} used relevance trees for their analyses. They started by asking about the reasons the government stockpiles (e.g., to cushion against interruptions or to assure a supply at a reasonable price), then asking about all the ways interruptions or price hikes could occur (e.g., monopolistic practices, labor shortages, international turmoil, etc), and so forth. Then they went on to assess all the ways that stockpiling could be done (e.g., as reserves, as ore, as processed ore, as scrap, etc.) or avoided (e.g., influence consumption, recycle, or find substitutes). The method is elementary, but its crucial contribution is that it forces people to think of all logical possibilities so that nothing is missed and it helps to structure a problem by breaking it into pieces and steps. It can be useful in arenas where little is known and where there is a need not only to explore possible consequences, but also to identify possible causal mechanisms that might operate or policies that might be undertaken.

Relevance trees become especially interesting for generating pictures of the future when they are combined with morphological analysis.\textsuperscript{123} This method takes pieces of a problem and asks the researcher to see how they might be combined. For example, someone thinking about future energy technologies might begin by listing all the forms of energy (kinetic, electrical, chemical, thermal, and nuclear) and then considering each of the steps in using energy (producing it, transmitting it, and storing or “consuming” it). Then they might consider the paths that might be possible for future energy systems such as kinetic energy from windmills turned into electrical energy for transmission, and then stored in chemical batteries or in dams where it can be recovered kinetically through gravity. The method’s strength is that it leaves no stones unturned, but its weakness is that it can quickly become the victim of exponentiating combinatorics. Just five forms of energy and three steps lead to 125 different energy architectures. Perhaps its biggest lesson is that we need ways of paring down possibilities as well as generating them.

Solving the combinatorics problem in generating scenarios of the future is at the heart of the oddly named “Field Anomaly Relaxation Method.”\textsuperscript{124} This method aims to develop a small number of scenarios that can cover most of the possible worlds that might occur. It starts by assuming that the future can be broken into not more than seven or eight sectors which might be economic conditions, environmental conditions, demographic conditions, and political conditions. Then each sector is assumed to have a finite number—say five to seven—basic values or “factors” such as fast growth, medium growth, slow growth, stagnant, or declining economy. A “configuration” or a “scenario” is a choice of one value for each of the sectors.

\textsuperscript{123} Tom Ritchey, 2018, “General morphological analysis as a basic scientific modeling method,” Technological Forecasting and Social Change, 126.
With seven sectors and five choices for each, the number of possible configurations is $5^7$ or 78,125. The next task is to eliminate “inconsistent” configurations. It would be impossible to go through all of these configurations, but the FAR method simplifies things by taking all pairs of possibilities of which there are, in our example, $5 \times 7$ things taken two at a time or $35!/(33! \times 2!) = 595$. It assumes that the elimination of a pair also eliminates any combination with this pair in it (so that if X and Y are incompatible, so are X, Y, and Z). In practice, the proponents of this method assure us that this task is feasible and that many pairs are eliminated. Finally, the remaining configurations are checked to make sure that each one makes sense. In the end, only a small number, we are told, of scenarios remain.

There are clearly many assumptions embedded in this procedure such as that values in seven or eight sectors can fully describe a future world, that five to seven values for each sector are enough to cover the possibilities, that possibilities can be eliminated using the pairwise method, and so forth. But whatever the utility of this method, it certainly demonstrates the Herculean task confronting someone who wants to think about possible futures, and it poses fundamental questions that need answers if we are to take scenarios about the future seriously. More generally, these methods provide approaches to thinking analytically about the system we are studying so that we can break it down into manageable pieces. These approaches are important because we often present students with pre-existing models without explaining how models can be constructed.

Explicating Preferences is Difficult

Harold Lasswell and Wendell Bell’s work described earlier provides a starting place for a checklist on preferences and goals, but there has been very little effort to extend their work and to develop a universal set of values. Among other things, more attention has to be given to identifying “rights” where tradeoffs are, at best, problematic and other kinds of values where tradeoffs are possible. Where tradeoffs are possible, cost-benefit and cost-effectiveness analysis and multi-attribute decision making have developed techniques to do so, but there remain many basic problems such as who should be the decision-maker and how should preferences be elicited? The futures literature, for example, has wrestled with questions about participatory technology assessment and participatory foresight. There is ample work here for political theorists. Lasswell’s work also sets an agenda for linking values to stratification systems and for asking what features of them are necessary (e.g., perhaps the need for incentives and rewards) or inevitable (e.g., perhaps judgments by people about the status of

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126 Boardman et al., 2018, op cit.
127 Keeney and Raiffa, 1976, op cit.
This endeavor leads to the expansive tasks of rethinking and redesigning stratification systems instead of simply accepting them as givens as in most policy analysis.

Causal Mechanisms are Hard to Identify
The difficulty of establishing causality is well known among methodologists. Yet futures thinking often requires at least some speculation about what events might follow others. “Futures Wheels” are one device to encourage (hopefully informed) speculation. In areas where those involved in thinking about the future are experts on the phenomenon being considered, it seems likely that this method could generate some useful results. Figure A-1 shows the results of a “futures wheel” generated by the members of an organization who are thinking about what the impacts will be of a 20% cut in their budget. The 20% cut is at the center of the wheel. The orange circles are first-order impacts placed around the initial event by those who participate in the wheel’s construction, the green are second-order placed after the first order impacts have been identified, and the blue are third-order. Although the device and the method are both very simple, one could imagine using this approach with experts who are considering the impacts of some new policy in order to generate hypotheses about what might happen.

**Figure A-1 – Futures Wheel for 20% Budget Cut**

![Futures Wheel for 20% Budget Cut](https://www.mindtools.com/pages/article/futures-wheel.htm)


One of the methods used to develop causal models in futures research is “system dynamics” which was most famously used to model the world’s economy and environment in the 1972 report on “The Limits to Growth.”131 System dynamics uses difference equations to model complex systems with stocks, flows, internal feedback loops and other features. Although practices are changing, initially the method did not try to validate the postulated equations or the numerical values of important parameters except insofar as the model, when it is run, mimics past behavior of the system and passes a test of plausibility. As a result, it was criticized as fundamentally not empirical. Some more recent implementations, however, have worked hard to provide empirical grounding for the model.132

Despite these concerns, some authors have defended it because it provided the first effort to get a sense of how earth’s systems worked together.133 Like the futures wheel, system dynamics models can generate interesting hypotheses about how complex systems with feedback loops might be structured and how they might operate. Thus it might also be a useful way to generate scenarios by making it easy to try many different structures and parameters. In fact, that is what a RAND team did in a 2003 report on climate change.134 They argued that:

“In general, a model designed for prediction will strive for validity through as precise as possible a representation of particular phenomenology. Thus predictive models may often prove ill-suited to producing the necessary diversity of scenarios and will require important modifications to serve as scenario generators. The more complicated models considered for use as scenario generators would have been much more difficult to modify because of their complexity, the lack of access to source code, or both. Consequently, they would not have offered an acceptable starting point for representing crucial aspects of the robust decision approach—e.g., consideration of near-term adaptive policies and the adaptive responses of future generations. As a consequence of these considerations, a simple systems-dynamics model known as “Wonderland,” based on the work of Herbert and Leeves (1998), was chosen as the scenario generator for this analysis.

The system dynamics method also forces researchers to think of an entire system, and it provides a language for thinking about interactions in a system. In those cases where the model is not the result of a long-term process of model validation, it must be considered more of a hypothesis generator than a real simulation. Indeed, alternative formulations with other

132 See, for example, the documentation for the “En-Roads Climate Solutions Simulator” that looks at energy production and greenhouse gas emissions. https://docs.climateinteractive.org/projects/en-roads/en/latest/index.html
assumptions lead to dramatically different results when system dynamics is used, although
some might consider this a useful way to learn about the range of possible futures.\textsuperscript{135}

A related approach is structural modeling (not to be confused with the econometric technique
of structural equation modeling). This method depicts relationships among variables as a graph
with points (or nodes) and connecting lines. If an ordering direction is specified for each
connecting line, the graph becomes a directed graph or digraph.\textsuperscript{136} The method only requires
the specification of causal relationships among variables without any parameter values. Fred
Roberts and Thomas Brown have used the method to model electricity demand in the power
grid.\textsuperscript{137} Using various mathematical notions of the stability of a system, they show under what
conditions the system is stable and when it is unstable. Perhaps most impressively, they make
the case for organizations that use a lot of electricity to pay more per unit so that energy use
cannot increase in dramatic increasing pulses that would make the grid hard to keep stable.

One lesson from these models is that the combinatorics of studying the future is daunting,\textsuperscript{138}
but another is that it is possible to glean important lessons from non-statistical models that
merely reflect possible causal relationships, sometimes (as with structural models) without
even any parameter indicating the sizes of the relationships among variables. From the
perspective of futures studies, that means that it is possible to make statements about the
future with very limited information.

Probabilities are Hard to Ascertain
Making statistical predictions about the future is especially hard to do despite the existence of a
vast number of forecasting methods as recounted recently in the 167 page, 80 author review
article in the \textit{International Journal of Forecasting} on “Forecasting: theory and practice.”\textsuperscript{139}
Rather than pursuing a description of statistical forecasting methods, we focus on the areas in
which futures analysis has made an impact. Probably the best known method to come out of
work by futurists is the Delphi Method. Lacking models, much less calibrated models, in many
areas, futurists soon became convinced that they needed a method to get the best possible
expert judgments. Their intuition (borne out by subsequent research) is that a group of experts
would provide better information than just one person. But how should expert judgements be
combined? In a paper published by the RAND Corporation in 1962, Norman Dalkey and Olaf
Helmer suggested the Delphi method in which people are brought together, asked to give their
expert judgments, typically in terms of probabilities, of various events and to provide their

\textsuperscript{135} Chaweng Changchit and Joe Mize, 1990, “World Dynamics Revisited: A Realistic World Model Simulation,” \textit{Socio-Economic

\textsuperscript{136} Harold A. Linstone, George G. Lendaris, Steven D. Rogers, Wayne Wakeland, and Mark Williams, 1979, “The Use of Structural
Modeling for Technology Assessment,” Technological Forecasting and Social Change, 14, 291-327

\textsuperscript{137} Fred S. Roberts and Thomas A. Brown, 1975, “Signed Digraphs and the Energy Crisis, \textit{American Mathematical Monthly}, 82: 6,
pp. 577-594.

\textsuperscript{138} An approach to dealing with the problem when models can be used is Robert Lempert, David G. Groves, Steven W. Popper,

reasoning. Then, in a second round all the participants (anonymously) see these predictions and reasons, and they are asked to reconsider their predictions. The goal is to get considered and well-though out predictions. The method has been widely used and there is even software to implement it online. A literature has also developed describing the biases that can occur with expert judgment and the ways to mitigate or reduce them.

A related method is cross-impact analysis that tries to develop a sense of how events or variables interact and are related to one another through the use of expert judgment. Ideally the method is meant to determine causal relationships, but it actually focuses on producing conditional probabilities such as “if X occurs, then the probability of Y increases by so much.” The method presents experts with a matrix of events with the same list on both axes, then the experts are asked how much the occurrence of one event would increase the probability of the others. For example, in a study of the future of the chemical industry, experts might be given events such as the use of plastics in transportation vehicles increases six-fold, increased government controls on chemicals, the development of chemical theory allowing computers to design chemicals with specified properties, etc. Then the experts would be asked to fill out the matrix with conditional probabilities. The results, of course, might violate the rules of conditional probability so that the method include a computer program that adjusts the probabilities to be consistent. These probabilities are then used to construct scenarios about the future. In effect, the approach amounts to using pairwise conditional probabilities to construct a “statistical” model of the future of some sector such as the chemical industry. The most elaborate use of this method is in the work of the French Futurist Michel Godet who christened it the SMIC method – System and Matrix of Cross Impacts. He also employed a panoply of similar approaches to construct scenarios.

All of these approaches are attempts to “make-do” when fully elaborated simulation models are not available. The gold-standard is statistical models that are calibrated with actual data, that use our best knowledge about causal relationships, and that provide stochastic results so that we can define confidence and prediction intervals. They should also be amenable to Monte Carlo simulations so that we can vary the inputs and see what differences that makes. But even fully elaborated models have their critics and defects. Indeed, in many areas, such as the regulation of risk, decisions have to be made before we have a full understanding of the causal mechanisms and basic probabilities. Consequently, although these futures methods may seem crude, they are often the best we have.

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143 This example is from Theodore Jay Gordon, 1994, “Cross-Impact Method,” AC/UNU Millennium Project, Futures Research Methodology
The Full Range of Possible Actions is Hard to Describe

In a path-breaking book published in 1992 called “Value Focused Thinking,” Ralph Keeney—one of the inventors of mathematical risk analysis along with Howard Raiffa and Ron Howard—made the argument that decision analysis had neglected some of the most important steps in making good decisions. He argued that values and alternatives had been given short-shrift and that a deeper analysis of values would almost always lead to the generation of more better decision-making alternatives. In a series of chapters entitled “Thinking about Values,” “Uncovering Hidden Objectives,” “Creating Alternatives,” and “Identifying Decision Opportunities,” Keeney provided methods for expanding the range of actions by exploring values. Although the word “futures” was not used, Keeney’s message was that decision-makers had to think about the future in order to develop imaginative actions and policies to bring about that future. Whereas his earlier work was rooted in problem solving that took the problem as given, this work veered toward constructivism—the future could be constructed if people would consider their values and work toward them.

The work also feels similar to a more overtly constructivist method proposed by John B. Robinson called “backcasting” that he developed in contrast with forecasting. “Thus, while the emphasis in forecasts is on discovering the underlying structural features of the world that would cause the future to come about, the emphasis in backcasts is on determining the freedom of action, in a policy sense, with respect to possible futures.” In a summary of backcasting methods, Elisa Bibri finds that there are four common steps in these methods: (1) Determine objectives and goals and develop a future vision, (2) Describe the current system and its operation, (3) Envisage a future situation that attains the goals while recognizing the need to get from the current system to that future situation, and (4) Find and implement strategies to attain that future. These methods have become especially prevalent and popular with those who are concerned with developing sustainable growth and development because they do not believe that the current path will lead to that so it is necessary to think of an alternative future and ways to get there.

Decision Rules are Not Clear-Cut

In situations where causal relationships are unclear, where probabilities are hard to determine, where goals are complicated, and where alternatives may develop as one goes along, the expected utility model does not work very well. In situations of deep uncertainty, other decision methods are necessary that hedge one’s bets, avoid the worst outcomes, provide for reassessments, make it possible to change course, and so forth. Developed mostly within the decision theory framework, decision rules such as minimax regret ensure that a decision-maker

avoids the worst outcome even when probabilities are not known, but even better strategies are possible. A whole series of methods have been developed to do this: Dynamic Adaptive Planning,\textsuperscript{149} Dynamic Adaptive Policy Pathways,\textsuperscript{150} Decision Scaling,\textsuperscript{151} and many others.

These methods have two basic features that distinguish them from decision problems where actions are typically taken at the beginning and then the results ensue. First they involve “robustifying actions” (see Figure A-2) taken at the outset of a plan to provide for flexibility in the future.

\textbf{Figure A-2 – Robustifying Actions to Make a Project Flexible}

- **Mitigating actions (M)**—Actions that reduce adverse impacts on a plan stemming from certain (or very likely) vulnerabilities.
- **Hedging actions (H)**—Actions that reduce adverse impacts on a plan, or spread or reduce risks that stem from uncertain vulnerabilities (much like buying car insurance).
- **Seizing actions (SZ)**—Actions that take advantage of certain (or very likely) opportunities that may prove beneficial to the plan.
- **Exploiting actions (E)**—Actions that take advantage of (uncertain) new developments that can make the plan more successful, or succeed sooner.
- **Shaping actions (SH)**—Actions taken proactively to affect external events or conditions that could either reduce the plan’s chance of failure or increase its chance of success.


Second, they involve constant monitoring and assessment of a project to see if it is on course or going in the wrong direction. This monitoring leads to “Monitoring Responses” like those in Figure A-3.\textsuperscript{152}

\textsuperscript{149} Warren E. Walker, Vincent W. J. Marchau, and Jan H. Kwakkel, “Dynamic Adaptive Planning (DAP),” Chapter 3 in Marchau et al., op cit.
\textsuperscript{150} Marjolijn Haasnoot, Andrew Warren, and Jan H. Kwakkel, “Dynamic Adaptive Policy Pathways (DAPP),” Chapter 4 in Marchau et al., book, op cit.
\textsuperscript{152} See Walker et al, 2019, op. cit.
Figure A-3 – Monitoring Responses to Get Projects Back on Track

Defensive actions (DA)—Responsive actions taken after implementation of the initial plan to clarify the plan, preserve its benefits, or meet outside challenges in response to specific triggers, but that leave the initial plan unchanged.

- Corrective actions (CR)—Adjustments to the initial plan in response to specific triggers.

- Capitalizing actions (CP)—Responsive actions taken after implementation of the initial plan to take advantage of opportunities that further improve its performance.

- Reassessment (RE)—A process initiated when the analysis and assumptions critical to the plan’s success have lost validity (i.e., when unforeseen events cause a shift in the fundamental goals, objectives, and assumptions underlying the initial plan).

ABOUT CALIFORNIA 100

The California 100 Initiative envisions a future that is innovative, sustainable, and equitable for all. Our mission is to strengthen California’s ability to collectively solve problems and shape our long-term future over the next 100 years. California 100 is organized around 15 policy domains and driven by interrelated stages of work: research, policy innovation and engagement with Californians. California 100’s work is guided by an expert and intergenerational Commission. Through various projects and activities, California 100 seeks to move California towards an aspirational vision—changing policies and practices, attitudes and mindsets, to inspire a more vibrant future.

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