Social Fabric Matrix:  
From Perspective to Analytical Tool  

F. Gregory Hayden

It is our proposition that only the substantive meaning of "economic" is capable of yielding to concepts that are required by the social sciences for an investigation of all the empirical economies of the past and present. . . . This requires a special tool box.

Karl Polanyi

Explanation often consists of substituting complex pictures for simple ones while striving somehow to retain the persuasive clarity that went with simple ones. . . . Seek complexity and order it.

Clifford Geertz

Two principles apply. First, there is the principle of association, which states that the developer of a model must engage in associating elements of representation systems with those things that are to be modeled. Second, there is the principle of model exchange, which states that it is desirable to find ways of transforming a model from one representation system to another to meet the needs of understanding, learning and effective communication.

John Warfield

The economic system is an evolving process and not a static equilibrium. This process undergoes a cumulative development in which various factors act and react upon one another in a cumulative process of circular causation.

Alan G. Gruchy

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As Gunnar Myrdal has said, "There is an inescapable a priori element in all scientific work. Questions must be asked before answers can be given." Myrdal also emphasized that "questions are all expressions of our interest in the world. They are at bottom valuations. Valuations are thus necessarily involved already at the stage when we observe facts and carry on theoretical analysis." Since fact gathering and theoretical analysis are basically ideological, it is important to develop analytical techniques consistent with the significant characteristics of the basic ideology.

One of the most significant characteristics of institutionalist thought has been a concern for the "evaluation of matters relating to economic welfare." But before policy scientists can evaluate from the institutionalist perspective, analytical techniques must be developed consistent with it. The consequences of a philosophical perspective can only be understood as it is applied in a social setting. Policy scientists can only operationalize a perspective through tools of analysis, and the tools must exist before analysis can proceed. The tool kit is not as important as the perspective, but it is imperative for giving the perspective meaning in any applied sense. Therefore, in order to extend evaluational analysis, this article will develop a process matrix consistent with institutionalist intentions. The matrix will be developed by tracing the evolution of the institutionalist paradigm, explaining the needs of a process, explaining the social fabric matrix, and suggesting some specific uses of the matrix. (The evaluative aspects of the matrix will not be developed here.)

Thorstein Veblen's Dichotomy

The evolution of the institutionalist evaluation paradigm begins explicitly with Veblen. Despite the complexity of the economic and social model Veblen elaborates, his main tool for evaluation was the technological-ceremonial dichotomy. This mode is reviewed with the aid of Figure 1. The analysis divides the world into two categories—that of social ceremonies and that of technology. Ceremonies are the habitual patterns of behavior based on emotions and social mores; they are therefore past-bound. Technology is the dynamic force which is constantly recombining and providing for new opportunities, thereby constantly disrupting institutional arrangements and ceremonial beliefs. Point 0 in Figure 1 indicates the opposition and contention between these two forces for evaluative dominance. Much of Veblen's analysis was approached in this mode for purposes of policy evaluation. Marc Tool has outlined a series of Veblen's dichotomous categorizations.
Veblen's Dichotomy

The power of this analytical approach has been recognized by institutionalists and systems theorists. An example of the latter is Kenyon De-Greene, who has stated that the unifying theme of systems evaluation is "how the human, that is, behavioral and social, subsystems affect and are affected by the nonhuman, that is, the technological, subsystem."\textsuperscript{7} Veblen's hope was to move economic evaluation away from using the world of ceremonial taste and emotion as expressed in the institution of demand. For Veblen, "institutions—the economic structure—may be roughly distinguished into two classes or categories, according as they serve one or the other of two divergent purposes of economic life . . . they are pecuniary or industrial institutions."\textsuperscript{8} He wanted to use the technological process and industrial science as an objective standard to provide a reasonable and abundant life for the population in general.

One problem with this dichotomy is that Veblen never developed the criteria for knowing whether a process was ceremonial or technological. To make this point, let us view the transaction of gall bladder surgery for the problem of gall stones. It might be observed that the technological
process consists of the knowledge, skills, hygienic procedures, surgical instruments, and equipment in the operating room. The ceremonial aspects might be observed to be the patient’s family praying in the waiting room and the insurance forms being processed in the accounting office. However, if enough gall stone cases are observed, it will become clear that the surgery is also usually ceremonial. In most cases it is possible to dissolve or remove gall stones by a combination of the patient drinking some oils and receiving external massages. Like much surgery, cholecystectomies are often for the pecuniary benefit of surgeons and hospitals. This example clarifies the possibility of making the Veblenian distinction without knowing the situational transaction and without establishing criteria. Veblen never developed the evaluative aspects of his paradigm, although “the normative use of this set of distinctions can hardly be in doubt.”

Clarence Ayres’s Philosophical Guidance

Clarence Ayres explicitly recognized that the purpose of Veblen’s dichotomy was evaluation. That is, the purpose is to decide what is bad and deleterious and what is good and efficient. For Ayres, “economics is nothing if it is not a science of value.” Thus, Ayres set about the task of developing the philosophical component as reflected in Figure 2. Ayres defines technology to include the tools as well as the skills necessary to operate and organize the tools. This includes intellectual technology and knowledge.

Ayres also said that social institutions, as well as technology, could be reasonable and instrumental in a given social situation. Like Veblen, Ayres recognized that the introduction of new tools would change social relationships and thereby change social institutions and norms. However Ayres did not see the introduction of new technology as automatically
good.\textsuperscript{13} It must be judged in view of the entire transaction. Ayres's concern for transactional analysis led him to John Dewey's work on instrumentalism. Ayres argued, as Anne Mayhew has stated it,

that there is a human process—the process of instrumental valuing—which allows people to learn by doing and, as they do so, to progress. He also argued that reasoning that this or that must be right because we have been told so by authority was a ceremonialism which inhibited... the free inquiry necessary for instrumental valuing. ... If the source of human progress resides in the process of instrumental valuing rather than in technology as artifacts, then it is the evaluation of the consequences of any particular use of the tool which is progressive. Ceremonialism is a failure to evaluate by testing consequences.\textsuperscript{14}

Ayres thus introduced Dewey's instrumentalism as the philosophical component of the evaluation paradigm. (The numerous subcategories of Dewey's instrumentalism are not displayed in Figures 2, 3, and 4.) As indicated in Figures 1 and 2, Dewey's instrumentalism as used by Ayres led to a change from Veblen. In Figure 1, social ceremonies and technology are in opposition. Such an opposition is not inherent in Figure 2. Either can be instrumental or either deleterious. For Ayres the legitimacy of an institutional pattern or tool process depends upon instrumental evaluation. There is no point of opposition; rather, instrumentalism should permeate the evaluative judgments about the integrated social and technological patterns. The philosophy category of Figures 2, 3, and 4 differs from the other categories in that the others are categories of reality, while instrumentalism is the selected philosophy to be applied.

\textit{Karl Polanyi's Social Evaluation}

Karl Polanyi's work had three main effects: (1) it expanded the areas of concern, as indicated in Figure 3; (2) it introduced the concept of sufficiency as an instrumental concern; and (3) it refined the understanding of the instituted process.

Polanyi emphasized the environment, which he defined as the basic flora and fauna upon which we must ultimately base our social structure and from which we must obtain our livelihood.\textsuperscript{15} For him the fount of the economy is the "process of interaction between man and his environment."\textsuperscript{16} He believed the "elements can be conveniently grouped as ecological, technological, or societal."\textsuperscript{17}

For Polanyi, the concern for maximization was a result of the market mentality, which made gain the central motive of human society.\textsuperscript{18} Most of Polanyi's work, in one way or another, commented on the illegitimacy of
the maximization principle instituted by the exchange system of market society. For him a sufficiency principle was necessary to evaluate and integrate a nonmarket society: "Insufficiency . . . is determined with the help of the simple operation of 'earmarking,' which demonstrates whether there is or is not enough to go around." 19

As indicated in Figure 3, sufficiency is added to instrumentalism as one evaluative criterion which must be applied. All the subcategories on the perimeter of Figures 3 and 4 do not bear the same relationship to their supra categories. Whereas institutions, values, and beliefs are components which define social ceremonies, such is not the case with the subcategories of instrumentalism. The subcategories of instrumentalism are some of the criteria which must be met in instrumental evaluation.

Karl Polanyi views ceremonies as patterns of behavior that define the relationships among the other elements of society—people, pig iron, pigeons, and prairie hay—are based on rules of prohibition, obligation, and permission. The social process evolves and enforces these rules as norms. At the core of the entire process are the cultural values with which activity-specific norms must agree. This agreement centers interest on values and beliefs. 20

The social process would not function were it not for the emotional and psychological commitment held by the people in any society to the norms of that society. Therefore, the psychological factors are crucial inputs in any production process. Writes Polanyi:

In the absence of any indication of societal conditions from which the motives of the individual spring, there would be little, if anything, to sustain the interdependence of the movements and their recurrence on which the unity and the stability of the process depends. 21
The psychological commitments are provided within and the social institutions structured from patterns of reciprocity, redistribution, and exchange (defined below).

**The Instrumental Elements of**

**Walter C. Neale and Marc R. Tool**

The work of Walter C. Neale and Marc R. Tool completes the instrumental concerns as presented in Figure 4.22

Before making instrumental evaluation and decisions, one must select criteria for judgment. For Neale, social consensus determines the legitimacy of the evaluative and analytical criteria. This is implicit in his many institutional studies and explicit in his policy concerns. Before one can begin policy analysis, one must have criteria to guide the scientific analysis. Before one can take a step in an inquiry, one must make judgments—about which data, about which techniques, about which logic. One must judge the analysis to be using the correct technique in the correct direction. The purpose of policy analysis is to structure social processes. "A requirement for social processes . . . is that they be legitimate."23 Legitimacy requires a social moral consensus on norms with regard to the consequences of social policy and with regard to the procedures which produce those consequences.24 Therefore, policy analysis for structuring social processes cannot be fruitful unless the social criteria guiding the policy analysis are fair and just.25 If there is not a social consensus on these criteria, then the resulting policy will be inconsistent with the social consensus.

For Marc Tool, the legitimate way to obtain social consensus and em-
bed it into social policy is through participatory democracy. Tool's work is consistent with that of Polanyi and Neale, and it extends Ayres's work on the application of Dewey to the economic process. Like Dewey, Tool believes that democracy is consistent with the process of scientific inquiry. Five reasons why Tool selects participatory democracy are: (1) it protects the community welfare and makes the policy analyst accountable; (2) it is an important mode of scientific discovery and social inquiry because the analysis benefits from the contributions of numerous people; (3) it is educational because the experience of participation requires that the participants become knowledgeable about the problem at hand and also that they be in contact with recent analysis. This provides for self-development and closes the gap between technocrats and the public; (4) it builds in information feedback loops and thereby avoids mistakes made when analysis is conducted in isolation from the impact nodes; and (5) it increases the chances that the resulting policy will be successful and lasting.28

The Process Matrix

The categories presented in Figure 4, although separated for explanatory purposes, are in fact instituted in many interdependent, transdependent, and recurrent ways to provide for the social process. For example, technology does not exist separately from social institutions, and the societal relations are in turn structured around a tool base. Likewise, the environment does not exist as unmolested nature, that is, there is no natural environment (no natural nature?). Both flora and fauna are embedded—sometimes to extinction—in the social and technical process. "The human economy, then, is embedded and enmeshed in institutions, economic and noneconomic. The inclusion of the noneconomic is vital. For religion or government may be as important for the structure and functioning of the economy as monetary institutions or the availability of tools and machines themselves that lighten the toil of labor."27 The matrix hereinafter developed exhibits the process characteristics of the institutionalist paradigm.

John Dewey explicated the methodological inadequacies of ends-means thinking. This means, as William Kapp explained,28 that institutionalist models should not depend on cause-effect (or stimulus-response) representations of reality. Underlying the causality approach is the assumption that a state of affairs (effects) is the result of a state of affairs at a prior time (causes). This defines actors and institutions as passive and memoryless to the extent that we assume that effects are determined wholly by the mapping of the causes onto the effects. However, active social systems are
maintained by the goals and rules changing with new situations and at different points in the process. A process is that transaction of transdependent entities; it is a collection of rules that accounts for the history of state transactions. It may include some interdependent or even dependent relationships, but the system process, as Rollo Handy has explained, can be defined as designating the full ongoing process in a field where the connections among the aspects and phases of the field are in common process. The transactional process approach, in contrast to the self-actional or interactional, is one in which "systems of description and naming are employed to deal with aspects and phases of action, without final attribution to 'elements,' or 'realities,' and without isolation of presumptively detachable 'relations' from such detachable 'elements.'" As Handy states, there is nothing mystical about using the holistic frame of reference to view "loans, borrowers, and lenders as aspects of a common transactional framework. Indeed, leaving out the 'system' in which the behavior occurs is surely to make unnecessary problems and difficulties. Separating the borrower from the loaning transaction does not make inquiry more scientific; it tends to obscure some important relations."

The remainder of this article will develop a process matrix consistent with the instituted process paradigm. The matrix is meant to capture the characteristics of the parts, as well as the process of the whole. This is accomplished by a nonequilibrium, noncommon denominator process matrix, as indicated in Figure 5. In this matrix, the ith row and jth column

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are the same entry, and cell i = j defines what the ith entity is delivering to the jth entry; or what the jth is receiving. The terms "delivering" and "receiving" are used purposely instead of terms such as "provided" or "required" because basic to this matrix is the idea that there is no final demand, absolute requirement, or end to the process. The participle form is used to denote the process as ongoing. "Process suggests analysis in terms of motion. It is processing or functioning as a "going concern,"
to use John R. Commons's term. Therefore, any event must perforce be traced through the matrix to find additional relationships. For most analysis the concern in the matrix will be divided to correspond to one aspect—let us say a government budget for a tax analysis—and then the relevant sequence can be "laid out" with the aid of digraph theory (Appendix I).

**The Social Fabric Matrix**

The five categories—values, beliefs, social institutions, technology, and environment—of the social transaction defined in Figure 4 will serve as the basic categories in an expository social fabric matrix. If Figure 4 is rearranged as in Figure 6, the construction of such a matrix can begin.

![Diagrammed Institutionalist Paradigm](image)

**Figure 6. Diagrammed Institutionalist Paradigm**

As indicated, the philosophical component (to the left of 0) would provide an overarching guide to the analysis of the system. This would include guidance to both the analytical techniques and the instrumental
Social Fabric Matrix

policy judgments. However, for a matrix of system articulation and description that component is removed. Figure 7 illustrates such a matrix exposition with a limited number of examples within each category. The example entries are taken from Western industrialized society and would be different for other societies. They are also too broadly defined to be of value for anything other than expository purposes.

To understand the matrix, let us begin with familiar terrain. Cells (4,4), (4,5), (5,4) and (5,5) are laid out as the standard industrial input-output matrix. Although the layout is the same, several differences exist. First, it is very apparent that the interindustry transactions are a minor part of the total process. To explain them, other entities outside the I/O table must be delivering. The emotional commitment must be delivered from the belief sector. The correct skills must be nurtured (3,6 and 3,7) and delivered (6,4) before the factories will operate. The government must provide the correct laws (3,4 and 3,5) to structure the industry. The environment must provide the lumber (8,14), and in turn the industry will deliver pollution to the environment (4,8). To look only at interindustry exchanges would provide no information for understanding an industry or for planning for it.

Second, the interindustry relationships do not automatically convert to pecuniary terms. Traditional I/O tables convert to pecuniary terms and lose the important information of substantive flow. The institutionalist's main economic interest is substantive, defined in terms of the quantity and quality of goods and services. For the planning of tool-skill delivery (7,5), it is the level of real flows which is important. The number of lathe operators should correspond to the number of lathes, which should correspond to real substantive output. This does not mean that pecuniary flows are not also of interest.

Third, contrary to the usual I/O tables, there is no "final demand" sector. In a system, no part of the process is final, and there is no simple demand concept which is said to be stimulating (causing) production. Defining the I/O tables in the traditional sense has made them too narrow, the coefficients too rigid, and the matrix too noniterative; this has doomed them to their current low esteem.

The I/O connection is, of course, only one of the characteristics. In addition to their not having a common denominator in the matrix, the relationships cannot be defined in terms of common properties. Some relationships are defined as flows, some as stocks, and some as criteria. To have a flow of wheat the environment must provide a stock of land, and people must apply a belief criteria to judge the appropriateness of the
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Figure 7. *A Social Fabric Matrix*
procedure. This means that standard algebraic manipulations are not appropriate for this matrix. It also means, consistent with holistic systems, that the rows and columns are not summative.

One characteristic which the matrix is not intending to convey is a system of harmony, or of exclusively want-satisfying delivery. Technology can be delivering cancer to workers (7,5), and the police can be delivering arrests to the family (3,1). Although both are part of the system, neither are wanted by the recipients.

Homeostatic equilibrium is also not implied by the matrix. Social processes are open systems, and open systems are not equilibrium systems. States Kenyon DeGreene, "A much stressed additional property of open systems is that of equifinality. This states that a system can reach the same final state from differing initial conditions and along a variety of paths."33

Values, although considered transcendental, are only transcendental through norms or beliefs which are activity-specific. Therefore, values serve as criteria only to beliefs, for example, in cells (13,10), (13,11), and (13,12). E.1 would not serve as direct criteria for A.1 through C.2. Values relate only directly with norms, only norms will be delivering to values. Stated differently, D.3 would deliver criteria to A.1 through D.2, but deliver satisfaction indices to E.1 through E.3. (See Appendix II).

There will need to be many different kinds of numerical modalities developed in order to capture the essence of the various relationships and their properties.34 Institutionalists have never thought it possible to find a single element in the system, such as money, or to design one abstractly that would serve as a common denominator. The social fabric matrix helps articulate the kind of data base that will be needed.

So What’s in the Boxes?

In developing the numerical modalities, the cellular data base must be designed to articulate the integrated institutional processes of reciprocity, redistribution, and exchange.35

Reciprocity means movements of goods and services among correlative groupings within a society; it is dependent upon a background of instituted groupings, with obligations to respond to common symbols, and with definite institutional enforcement of the expected response through law or custom. Simple reciprocal behavior based on the congeniality of neighbors is not reciprocity because it is not organized, integrated, and enforced by institutional arrangements. It can dissolve and therefore society cannot depend on it. "Reciprocity behavior between individuals integrates the economy only if symmetrically organized structures, such as a symmetrical
system of kinship groups, are given. But a kinship group never arises as the result of mere reciprocating behavior on the personal level.\textsuperscript{36} Economic integration through reciprocity plays a major role in some complex societies; thus, it is apparent that it is not limited to dual relationships. Numerous groups can be involved, and groups need not reciprocate with one another directly but through corresponding members of a sequence of other groups.

\textit{Redistribution} means the movements to a center and out again; it is therefore dependent on viable institutions of centricity. "It presupposes the presence of an allocative center in the community, yet the organization and validation of such a center does not come about merely as a consequence of frequent acts of sharing as between individuals."\textsuperscript{37} A system is redistributive if goods and services are collected into a center "by virtue of custom, law or \textit{ad hoc} central decision."\textsuperscript{38} In some cases it is accomplished by the physical movement of goods to inventory centers for later distribution; at other times it is not physical, especially in the case of intangibles, but an appropriational redistribution with regard to the rights of disposal. Societies at various levels of affluence and technology, including the Tasaday and the Soviet Union, have depended on integration through redistribution.

\textit{Exchange} means the market system, with fluctuating prices determined by the institutions of supply and demand. Exchange as an integrative system need not be explained here.

Not every cell in the matrix exhibits a relationship guided exclusively by these integrative patterns. An example is cell (8,9), which represents a relationship between forest and land. There is environmental delivery without social institutions being involved. That information is still important in the holistic system because that environmental delivery will influence what the patterns of reciprocity, redistribution, and exchange can prescribe for land to deliver to other sectors in other cells.

In most societies, all three patterns of integration exist to some extent. This is especially true in the West, where the strong vestiges of the market system still exist even though the system is being transformed to depend more on reciprocity and redistribution. A simple and incomplete example is outlined in Figure 8.

\textit{R}_1 is a farmer who, because of a reciprocal inheritance law, must provide part of his yearly income to his brother, \textit{R}_2, who is a professor and member of the tax-paying middle class. Because of a distributive tax law, \textit{R}_2 must pay income tax to the national government, \textit{C}. \textit{R}_2 must also, because of a reciprocal custom, provide gifts to his in-laws' daughter, \textit{R}_3, who is a college student. \textit{R}_3 is also \textit{E}_3 because of an exchange relation in
which she manages an apartment house for \( E_1 \), an apartment owner. She is paid in kind with free rent.

\( E_1 \) buys apartment furniture from \( E_2 \) in an exchange relationship, and buys lawn seed and lawn chemicals from \( E_4 \). \( E_4 \) is a conglomerate agribusinessman who, in addition to owning the local seed, feed, and chemical store, is also \( R_4 \), the step brother of \( R_1 \). Therefore, because of reciprocal custom, \( R_4 \) and \( R_1 \) assist each other in their farming operations.

\((R_4, E_4)\) pays income taxes to the national government on his retailing profits. \( R_1 \) pays no income taxes because of \( C \)’s rules on agriculture cash expensing, and \( R_3 \) pays no income taxes because \( C \) does not tax gifts and does not pursue small in-kind payments. \( E_1 \) does not pay taxes because of \( C \)’s real estate depreciation laws. \( R_1 \), \( R_3 \), and \( E_1 \) receive farm subsidies, education, and reduced interest rates, respectively. It can also be noted in Figure 8 that supporting each economic relationship is a technological Matrix of Environmental Residuals for Energy Systems (MERES) (see Appendix III).

We can see from this simple example how impossible it would be to attempt to understand the modern economy without a tool such as the social fabric matrix. It also becomes evident that the personal actions are organized and guided by the integrative forms discussed above. There-
fore, it is more orderly and more fruitful to organize a study around the five categories contained in the social fabric matrix.

Since the five categories—values, beliefs, institutions, technology, and environment—are integrated through the processes of reciprocity, redistribution, or exchange, data must be collected for each relevant cell with regard to which integrative form is patterning the delivery to the recipient element represented in the cell. For example, Industry 1 may be delivering part of its product to Industry 2 (4,5) through a cartel arrangement (reciprocity), and part of it by selling in the open market (exchange). The data base needed to define each cell is the sufficiency level, the locational aspects, and the appropriative aspects.

The sufficiency level is the amount delivered to meet the needs of the system—for example, the specifications of a contract or agreement. The locational aspects are twofold: the movement of goods as well as the beginning and ending spatial positions. "Locational movements include production alongside of transportation, to which the spatial shifting of objects is equally essential." This is crucial to regional analysis. "The appropriate movement governs both what is usually referred to as the circulation of goods and their administration." The circulation results from transactions as between hands. The administration results from dispositions of a one-sided act of the hand. This data base should allow us to capture the structure of the economic system.

**Summary by Way of Hopes and Expectations**

This kind of matrix is meant to assist in describing the system and providing the data base for evaluation and planning, especially in a complex technological society. As David Harvey has said, "we must seek to understand the mechanisms of reciprocity, redistribution, and market exchange, as they unfold in an extra-ordinarily complex space economy. This space economy contains hints of previous spatial forms and in some cases is bound down by these previous forms. But the territorial sprawl which contemporary megalopoli characteristically exhibit, means . . . that the process . . . cannot be analyzed in any simple fashion . . . of territorial distinction." The remaining discussion will deal with particular concerns for which the social fabric matrix may have relevance.

First, the expectation is that the institutionalist paradigm, especially with regard to the patterning of reciprocity, redistribution, and exchange, can be applied for policy purposes in a much more complete sense in advanced technological societies.
Second, the author expects that it will serve to close the gap between the institutional perspective and many system techniques now in use, such as cross-impact analysis, MERES, digraph theory, Warfield interaction system, network analysis, and so forth. Future work should determine which of those are consistent with the social fabric matrix.

Third, for policy to be implemented, planning must be completed. The matrix is meant to extend the work of such planning advocates as Rexford Tugwell and Allan Gruchy. Their concern for the land is a case in point. Tugwell said that “intelligent use of the land is the first criterion of any civilization. The fertility of the soil is the ultimate source of wealth. When that is gone, the civilization built upon it soon decays.”42 Gruchy agreed that “a nation which does not bend its efforts toward the preservation of its land and other natural resources cannot hope to preserve its culture for any considerable length of time.”43 With the social fabric matrix, row C.2 can be used to discover the current uses of land and what kinds of appropriate transactions are degrading it. Column C.2 can define the effects that are directing its use. “Land is . . . tied up with the organizations of kinship, neighborhood, craft, and creed.”44 It is also affected by technology and other parts of the environment. This kind of analysis should help overcome Tugwell’s criticism of vagueness on the part of institutionalists and provide for the close incisive analysis that he was requesting.45

Fourth, the matrix should help with the legitimacy concerns of Walter Neale, George Lodge, and Geoffrey Vickers in directing social psychologists to design new beliefs consistent with the needs of a communitarian society.46 The matrix can indicate what beliefs are currently used to justify the activities and governing rules of the various columns, and what the results might be if alternative beliefs were substituted.

Fifth, the matrix should be helpful in technological assessment. Institutionalists traditionally have had a great interest in technology and the impact of changing technology. The disruption of institutions and beliefs, as emphasized by Ayres, can be observed if a change in B.1 is traced across the relevant columns. These changes would, in turn, affect their respective rows. The direct and indirect effects can be assessed and evaluated to determine the appropriateness of new technology.

Sixth, J. K. Galbraith’s “technostructure” and Louis Junker’s “Scientific-Technological Process” contain elements similar to the social fabric matrix and are based on the same ideas. Junker says of his process:

That process understood in the Technological relations perspective involves, at one and the same time, and as dimensions of each other,
Things (tools, symbols, machines); Skill (behavior with things in a productive manner); Organization (coherence and integration of relationships in behavior with things); Administration (decision-making about coherence and integration of relationships in behavior with things); and Values (evaluational criteria for the overall monitoring and adjusting of decision-making about coherence and integration of relationships in behavior with things).47

The social fabric matrix should assist in defining the “integration of relationships” and the “dimensions of each other.” Expressing Galbraith’s technostructure in this manner should show that it is not a thesis of technological determinism.

Seventh, the matrix should assist historians in providing studies which compare systems at different points. Most historical studies have been just chronological tracking, without justifying the use of Pope Gregory’s calendar as the tracking guide. Of course, changes in dates do not change societies. Therefore, historians should be comparing systems and the changes in systems. Generally, historians have offered so little in a system sense that some systems theorists are now claiming that history has no relevance to understanding a system, and that “knowing the past of the system [is] useless information.”48 The author disagrees; a system element can be understood only in the context of a system, and the same element, let us say physicians, may have different functions in different systems. In one a physician may direct preventive measures which reduce environmental niches for diseases; that is, control disease before it reaches the population. In another system, the same element with the same skills may deliver injections, that is, destroy disease after it reaches the population. In one case the physician is an administrator of environmental personnel, in the other the observer of ill bodies and dispenser of drugs.

The only way to know how system elements will behave and react is by knowing the evolution of the system and its elements. Historians can provide that for us in the form of a social fabric lattice for different points in the evolutionary process.

Eighth, an actor table can be identified from the matrix once the relationships have been established. As Polanyi implied, vital for plans is the alternative methods necessary for instituting them.49 One of those vital methods, according to Robert Keith and David Fischer,50 is changing actor attitudes and beliefs in order to develop new behavior patterns. The actors and their beliefs can be developed from the matrix.
APPENDIX I

*Staged Digraph Map*

![Diagram with stages and nodes labeled 1 to 15, showing the flow from Stage 1 to Stage 6.](image-url)
APPENDIX II

Expansion of Bush's Structural Characteristics

Briefly it may be well to note that the value concept here is an expansion of the one presented by Paul D. Bush.* A layer of transcendental values, consistent with the work of Milton Rokeach,** has been added to Bush's behavior-specific values. What Bush terms "values" are here being termed "beliefs." In this paper, behind each belief is a layer of transcendental values—transcendental with respect to all beliefs. These values do not change as the beliefs and the system change.

If we represent each value by $V$, then the value set can be represented by $N \times 1$ vector as:

$$
\begin{bmatrix}
V_1 \\
V_2 \\
\vdots \\
V_n
\end{bmatrix}
$$

and if we represent Bush's values as $v$ instead of $V$ to represent behavior specific beliefs, Bush's axiom #4 can be expanded to encompass transcendental values. This means Bush's general expression of $B V B$ becomes $B v B$, which the author will rewrite as $v:BB$. Therefore axiom #4 would be expanded to fit this paper as:

$$
\begin{bmatrix}
V_1 \\
V_2 \\
\vdots \\
V_n
\end{bmatrix} : v:BB
$$

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APPENDIX III

*Technological MERES*

<table>
<thead>
<tr>
<th>Resource</th>
<th>Extraction</th>
<th>Transportation</th>
<th>Processing</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>Longwall</td>
<td>Room Pillar</td>
<td>Truck</td>
<td>Unit Train</td>
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<td></td>
<td>Auger</td>
<td></td>
<td>Conveyer</td>
<td>Mixed Train</td>
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<td></td>
<td>Strip (Under 15°)</td>
<td>Mine Rail</td>
<td>Coke Clean</td>
<td>Steam Clean</td>
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<td></td>
<td>Strip (Over 15°)</td>
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<td>Break Size</td>
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<td></td>
<td></td>
<td></td>
<td>Conveyer</td>
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<td>Oil</td>
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<td>Supertanker</td>
<td>Tanker</td>
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<td>Onshore</td>
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<td>(Product Imports)</td>
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<td>Offshore</td>
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<td>Tanker</td>
<td>Barge</td>
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<td>process Units</td>
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**SOURCE:** Adapted from Brookhaven National Laboratory, Energy/Environmental Data Group, 1974, “The Reference Energy System and Associated Database.”

*MERES: Matrix of Environmental Residuals for Energy Systems

Figure 1. Energy Supply Systems
These concepts are illustrated in Figure 1, which shows the coal, oil, and natural gas systems as contained in MERES. Activities are identified across the top of the figure. Processes are indicated by the labeled horizontal lines. A trajectory involves one process from each activity, moving from left to right across the diagram. For example, room and pillar mining, conveyor belt transportation in the mine, breaking and sizing, unit train distribution, above-ground storage, electric generation, and transmission to a specific electrical end-use define one complete trajectory. Sometimes an energy system is also referred to as a subsystem because it is a piece (or “sub-system”) of a larger energy supply system.
Notes

2. Ibid.
5. This kind of dichotomous approach has been common since Richard T. Ely’s work. J. R. Commons used it also; for example, the distinction between use values and exchange values in his *Legal Foundations of Capitalism*. In this tradition, a more recent and elaborate dichotomy is in George Lodge’s *New American Ideology*.
13. Ibid., pp. 513–514, 517.
15. By making the environment an integrated part of the transaction, Professor Eric Zimmerman’s voluminous and important work can be integrated into the analysis. For example see: Eric Zimmerman, *World Resources and Industries* (New York: Harper & Bros., 1951).
17. Ibid., p. 249.
20. Ibid., p. 250. The author has substituted the word “beliefs” for “motives” to make it more consistent with modern terminology.
21. Ibid., p. 249.
22. The concerns of John R. Commons are very similar to those in Figure 4 although he did not integrate them in this manner. The difference is that
his transaction would now have to contain more than five persons.


31. Ibid., p. 25.


35. The explanation here of reciprocity, redistribution, and exchange is a summary of Karl Polanyi's explanation in Polanyi, "Instituted Process," pp. 250–256.

36. Ibid., p. 251.

37. Ibid.

38. Ibid., p. 253.

39. Ibid., p. 248.

40. Ibid.


43. Ibid., p. 443.


