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*Transitions: An Institutional
Perspective*

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Transitions: An Institutional Perspective ¹

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Abstract

A transition to a new technological regime is complete (and stable) when accompanied with a co-stabilization between the mode of regulation and the regime of accumulation. Key to understanding the dynamics of transitions are the factors, including institutions, that “regulate” and stabilize the regime of accumulation over time. However, the available frameworks for institutional analysis employ arbitrary and narrow definition of institutions, focus mainly on the policy domain, and do not pay sufficient attention to the evolutionary characteristics of change as manifested in emergence of numerous institutions that underlie transitions. This paper consists of three parts. The first part critically reviews and synthesizes some of the main approaches for conducting institutional analysis. The second part rearticulates the concept of “transitions”, or technological regime shifts, from a systems perspective to make a case for investigating transitions as multi-level, multi-scale, and multi-system phenomena best understood in their institutional contexts. The third part proposes a framework for examining institutional change and demonstrates how this framework may be used to identify the key factors and conditions whose convergence might result in transitions in a given subsystem. Examples are drawn from the Dutch waste management subsystem to demonstrate how this framework should be operationalized.

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1. Introduction

The mass use of the automobile became socially embedded in a co-evolutionary process that saw societies build new infrastructure, set up new formal institutions such as licensing agencies, devise new rules such as traffic laws, devise means of coercion such as the traffic police, and change consuming behaviour so that the general populace wanted (and later needed) automobiles. The emergence of the automobile sector also gave rise to the formation of new associations such as carmakers' lobby groups, mass social organizations such as trade unions, and technical societies all of which in turn regulated, in specific and broad terms, the automobile industry and the later generations of automotive technologies. The historical dynamics of automobile use is captured through the notion of "transitions". A transition is a transformation process through which a new technological regime is established (Kemp, Schot, and Hoogma 1998). Transitions are evolutionary phenomena and embodied in systemic processes that combine new and old elements to generate a new technological regime.

Drawing examples from the Dutch waste management subsystem this paper proposes a framework for examining institutional change and demonstrates how this framework may be used to identify the key factors and conditions whose convergence might have resulted in transitions in the subsystem. The proposed framework assumes that in a subsystem some institutional variables are more significant than others. This assumption allows focusing on the most important variables, simplifies analysis, and makes the approach and its findings more accessible. This paper consists of three main parts. The first part reviews and synthesizes some of the main approaches for conducting institutional analysis. The second part rearticulates the concept of transitions, or technological regime shifts, from a systems perspective to make a case for investigating transitions as multi-level, multi-scale, and multi-system phenomena best understood in their institutional contexts. The third part proposes a framework for examining institutional change and demonstrates how this framework may be used to identify the key factors and conditions whose convergence might result in transitions in a given subsystem. The Dutch waste management subsystem is used to demonstrate how this framework should be operationalized.

2. Review of Frameworks for Institutional Analysis

Numerous and different types of variables shape the dynamics of a transition in a subsystem. A subsystem may be a policy domain, cluster of firms, industrial sector, or region. The institution of a transition is closely associated to a set of factors, or variables, some of which play more central roles than others. In studies of transitions a common difficulty is determining the most significant factors that facilitate and subsequently institute a transition. To a large extent this difficulty arises from the complex context in which transitions occur. A transition is said to have occurred when a technological regime becomes stable and increasingly irreversible, a process that may also be referred to as "social embeddedness" (Granovetter 1985). Social embeddedness is facilitated by a multiplicity of formal and informal "institutions" which co-evolve with the emerging technological regime. These institutions are manifested as standard patterns of interaction among individuals and groupings of

individuals, e.g., organizations, and give rise to distinct modes of behaviour and codes of conduct.

The co-evolution of institutional forms and transitions is complex, many-sided, and perhaps comprehensible only after the event. Studies of transitions to inform policy must recognize this complexity and begin with an attempt to unpack and drastically disaggregate the notion of “institution”, to paraphrase Nelson (1995). Transitions institute new power hierarchies, depend on learning (and unlearning), and tend to undermine the stability of previous transitions. Thus, institutional analysis of transitions needs to recognize the centrality of power in agency-structure relations (DiMaggio 1988, Hirsch 1997, Oliver 1991, Perrow 1985, Scott 2001, Stinchcombe 1997) and the evolutionary nature of economic activity, including the parts played by cumulative causation, path-dependency, and lock-in.² This means asking concrete or many-sided questions, following arguments and processes “wherever they lead” (Sayer 1999), applying several different theoretical perspectives (Stinchcombe 1968), and drawing on multiple inputs from diverse disciplines (Ostrom 1999) to ensure the adequacy and widespread applicability of the analytical framework. Conducting institutional analysis must thus be a multi-scale, multi-level, multi-system, and integrated endeavour – that is, no situation or institution should be viewed as unrelated to, or fully isolated from, other situations or institutions.

Institutional configurations should be viewed as nested, hierarchical structures. Certainly, simplifications and assumptions need to be made about the internal and external factors that affect the domain under study. The frameworks reviewed in the next section all make such simplifications. With the exception of Hayden’s “Social Fabric Matrix” all these frameworks almost exclusively focus on the dynamics of the policy-making arena and their implications for societal change. The common thread linking these approaches is the varying emphasis placed on the role of institutions in societal change.

2.1 Social Fabric Matrix

In three papers, Gregory Hayden builds on the institutionalist approaches of Dewey (1954), Foster (1981a, 1981b), Swaney (1987), and Mattessich (1978) to outline the “Social Fabric Matrix (SFM)” as an analytical method for operationalizing the institutionalist approach (Hayden 1982a, 1982b, 1982c). The SFM is used in subsequent papers to analyze specific case studies, drawn from the realms of natural resources and ecosystem management (Hayden 1991), transactions among

² *Path dependency* may be described as “dependence on initial conditions” (after Arthur 1990), or a recurring emergence of initial conditions, resulting in relative permanency (Hodgson 1988; 1993, 1999) of particular habits / customs and institutional forms. *Cumulative causation* is closely associated with the better-known economic concept, the “multiplier effect”. Cumulative causation is thus defined as the unfolding of events connected with a change in the economy (Myrdal 1957) due to the appearance of a new enterprise which may be private, e.g., a factory, or public, e.g., a government institution or a public-private partnership. *Lock-in* and its relationship with path dependency and cumulative causation captured through the oft-cited case of how the QWERTY keyboard arrangement, despite proven inferiority to other arrangements, evolved to become the standard in keyboard arrangement (Liebowitz and Margolis 1995:210) or how Microsoft has maintained its hold over the vast personal computer market despite the availability of other viable technologies.

corporations (Hayden and Stephenson 1992), and policymaking (Hayden 1993). The SFM is based on the concept of delivery and process (Hayden 1982b). Electric companies “deliver” electricity, novels deliver myths, values deliver belief criteria, and some industries deliver carcinogenic substances. Designing an SFM requires first defining the matrix components (table 1). Hayden (1993:308-11) identifies and defines seven major components for integration into the SFM. These are cultural values, social beliefs, personal attitudes, personal tastes, natural environment, technology, and social institutions. The flows of goods, services, information, funds, and people through the network represented by SFM, both structure and maintain “community relationships”. Depending on the subject of study, the SFM may attribute more or less weight to each of the seven components.

An SFM integrating the seven components should, as real-world systems do, depend on delivery among the component parts, or elements, denoted by (1..n) for each component in table 1. Examples of elements that might be included in the (1..n) range are provided in table 2. For example, the natural environment has to be viewed as delivering nitrogen-fixing bacteria as well as floods. Similarly, factories deliver output as well as generate employment and pollution. The system continues to function as long as there is delivery among its components consistent with natural principles and social rules. A “sustainable” system has continuous delivery and receipt among its many components and no delivery-receipt relationship undermines the continuance of relationships among other components. One main purpose of the SFM is to organize what we know as the basis to identify other components and linkages.

TABLE 1

After the accumulation of relevant knowledge, the task is then to construct a list of the main components and elements of the components that make up the real world. “Delivering Components” shown in the first column in table 1 correspond with “Receiving Components”, shown in the first row: “Some of the deliveries will include criteria, court rulings, pollution emissions, goods production, services, and so forth”. The completion of the SFM for a research problem should result in discovering linkages among elements and the identification of research gaps (Hayden 1993:312-3). Placing a notation of “1” in any cell in table 1 denotes the existence of a delivery / receipt relationships. If there is no relationship, a zero is entered into the appropriate cell. The number of cells in the SFM depends on the research or policy problem being addressed, i.e., it is scope-dependent. Links or relationships between deliveries and receipts are established on the basis of *Reciprocity*, and/or *Redistribution*, and/or *Exchange*.

The information processed to establish delivery / receipt relationships and entered into the matrix can be used to define the system sequence. The completed matrix can be converted to a Boolean digraph (directed graph) to indicate delivery and receipt processes to allow for the identification of the central nodes of the network. Digraphs highlight overlapping inter-relations among entities through the flows of personnel, funds, goods and services, and information (tacit and codified) which structure and

maintain community relationships (Hayden 1993:312). The central nodes are entities or phenomena that are involved in more overlaps, have more reachability to other entities, and generate greater levels of deliveries, in terms of flows, than other entities or phenomena. Using the SFM, it is possible to identify the relevant set of influences that shape the behaviour of a system (Hayden 1998:94). As a means to model action processes, the SFM can be used to select the most important components, or regulatory factors, through highlighting the delivery and receipt relationships. Depending on the number and importance of the most central node(s), one might speculate about the resilience of the network or the stability of a particular institutional arrangement as a whole, were one or more of the central nodes to be eliminated or diminish in importance.

TABLE 2

Because the SFM has not been widely utilized in empirical work it remains unclear how the significance of each variable and its relationships with other variables can be determined. Also, despite its inherent usefulness in highlighting the key variables and their inter-relations, the SFM provides only a snapshot, albeit a highly elaborate one, of institutional arrangements without accounting for the continuous change dynamics that characterize institutional arrangements, particularly in times of acute crises. The analysis of how institutions change over time is the subject of study for frameworks based on “Institutional Rational Choice” (IRC). IRC is primarily concerned with rule changes in the formal institutions of government. A much cited extension of IRC is Elinor Ostrom’s (1999) “Institutional Analysis and Development Framework”(IAD). IAD, discussed in the next section, focuses on tracking changes in institutional arrangements, evaluation of changes in policy outcomes, and the implications these outcomes for future policy.

2.2 Institutional Analysis and Development Framework

Ostrom (1999) describes the Institutional Analysis and Development (IAD) framework starting with some working definitions. To deal with the multiplicity of meanings for institutions Ostrom (1999) views institutions as “shared concepts used by humans in repetitive situations organized by rules, norms and strategies”. Rules are shared prescriptions based on must, must not, or may which are enforced by agents responsible for monitoring conduct and imposing sanctions. Norms are shared prescriptions conformed to by the participants through internally and externally imposed costs and inducement. Strategies are plans made by individuals based on their knowledge of the structure of incentives produced by rules, norms, and expectations of behaviour of others (Ostrom 1999:37). Ostrom’s emphasis on “rules-in-use”, as opposed to “rules-in-form”, resonates with Nelson and Sampat’s (2001:40) variant of institutionalism which views institutions as “how the game is played” as opposed to North’s (1990) “rules of the game”. Like Ostrom (1999), Nelson and Sampat (2001) make allowances for the internalization by the agents of the rules, norms, and expectations of behaviour.

The conceptual unit of analysis for IAD is the *action arena*, which consists of an *action situation* and the *actors* in that situation. Action arena is the social space where individuals interact, exchange goods and services, solve problems, dominate one another, or fight (among the many things that individuals do in action arenas). There are seven clusters of variables in an action situation: participants, positions, outcomes, action-outcome linkages, the control that participants exercise, information, and the costs and benefits assigned to outcomes. An actor is characterized by the *resources* brought into the situation; the *valuation* the actor assigns to states of the world and to actions; the way the actor acquires, processes, retains, and uses *knowledge contingencies and information*; and the processes the actor uses for *selection* of particular courses of action (Ostrom 1999: 41-2). To understand the “rules-in-use” the institutional analyst needs to identify “entry and exit rules” for the participants; “position rules” of the participants; “scope rules” relating to geographic or functional domains as understood by the participants; “authority rules” from the participants’ perspectives on what is mandatory, forbidden, or authorized; “aggregation rules” relating to permission from or agreement of others on adopting certain practices; “information rules” relating to what is proprietary and what is public; and “payoff rules” which determine the type and size of sanctions and incentives and how conformance to the rules is monitored (Ostrom 1999:52-3).

Institutionalist analysis in the manner described by Ostrom (1999) is aimed at understanding the initial structure of an action arena, enquiring into factors that affect the structure of an action arena, and explaining complex structures that link sequential and simultaneous action arenas to one another. The IAD framework in addition identifies patterns of interactions and outcomes and evaluates the outcomes (Ostrom 1999: 41). The predictability of the outcomes depends on the action arena and its constituent parts (i.e., the *action situation* and the *actors*). In an environmental conflict, for example, actor individuals may be embedded in communities where the initial norms of fairness and conservation (or the opposite) structure the situation dramatically. In these situations, participants (single individuals or organizations) may adopt a broader (or narrower) range of strategies. Actors may also change their strategies over time as they learn about the results of past actions. Because of the high level of uncertainty in such situations, the ability to predict outcomes is significantly diminished. Often what is possible is to predict what will *not* occur, useful when reforms are being contemplated (Ostrom 1999:47). The next step in the IAD framework is the evaluation of the outcomes being achieved, outcomes that could be achieved under alternative institutional arrangements, and the processes of achieving outcomes (Ostrom 1999:48). The evaluation criteria are not predetermined but could be based on such concerns as economic efficiency, equity, and accountability. Policy process evaluation may also be carried out using criteria defined for sustainability, for example.³ The IAD framework may be used to examine multiple action arenas and assess change trajectories based on alternative policy scenarios.

The main principles underlying the IAD framework are a systems view of the policy process as complicated and complex, simultaneous focus on the policy process as well as outcomes, emphasis on the need to evaluate actual and potential policy outcomes, and recognition of the actors’ intransigence to change their core beliefs (“deeper level

³ For a comprehensive set of sustainability criteria see Gibson (2001).

rules”). Despite its significant contribution to institutional analysis, IAD lacks the clarity of some of the other frameworks such as Sabatier and Jenkins-Smith’s (1993, 1999) “Advocacy Coalition Framework” (ACF) and Kingdon’s (1984 [1995]) “Policy Streams Approach” (PSA). In addition, there is an implicit assumption in IAD that institutions primarily “constrain”, rather than facilitate, policy change. This one-sided view of institutions as constraints is contested by Hodgson (1988), for example, among others. Despite the emphasis on the “rules-in-use” by actors in “action situations”, the IAD framework focuses on the actors’ institutional affiliations to the detriment of paying additional and sufficient attention to the dynamics of the action situation. The action situation is more extensively analyzed through the ACF and PSA. These latter frameworks attach great importance to the politics of policymaking and attempt to simplify the “messiness” of the policy arena. These approaches are discussed in the next two sections.

2.3 Advocacy Coalition Framework

The policy process according to Sabatier (1999) is “an extremely complex set of interacting elements over time”.⁴ The Advocacy Coalition Framework of policy change (ACF) emerged in part out of a “desire to synthesize the best features of the top-down and bottom-up approaches to policy implementation” and “a commitment to incorporate technical information into a more prominent role in our understanding of the policy process” (Sabatier and Jenkins-Smith 1999:117). Because of complexity and “complicated situations”, analytical work in policy “subsystems” (or domains) necessarily has to be based on a series of assumptions about what variables and which causal relations are more important than others. These assumptions constitute the conceptual lens for the analyst. The point of departure for Sabatier and Jenkins-Smith (1993, 1999) is that since conceptual lenses are inevitable (because of complexity), analysts should be explicit rather than implicit about their assumptions so as to “invite critical scrutiny of their key variables and causal relationships in terms of their logical properties – clarity, logical consistency, scope, fruitfulness – and in terms of the receptivity of their principal propositions to empirical verification” (Sabatier and Jenkins-Smith 1993:xi). Discourse on adequacy or inadequacy of conceptual lenses could then be expected to lead to revision, retesting, and sometimes rejection of underlying assumptions.

⁴ Sabatier (1999:3-4) summarizes the reasons for this complexity as follows:

- involvement by (often) hundreds of public and private interest actors (with counterposing values and perceptions) in some or all aspects of the policy process;
- outcomes of policy debates given counterposing values and perceptions of actors involved;
- relatively long time span of a decade or more that characterizes the entire policy process – from the emergence of a problem through to the formation of policy and learning from the evaluation of policy impact;
- multiplicity of policy programs and the scales at, through, and over which the programs are intended to operate make for situations with considerable overlaps among programs and different geographical, social, economic, and political domains; and
- power, due to conviction based on deeply held values and interests, wealth and money, and authoritative coercion – hegemonic quests by actors are often manifest as selectivity in presenting evidence, misrepresentation of opponents’ positions, coercion to discredit opponents, and distortion of the policy debate process to one’s own advantage.

A “subsystem” consists of groups of individuals and / or organizations (actors) organized into “advocacy coalitions” that interact regularly over periods of a decade or longer to influence policy formulation and implementation within a given policy area or domain.⁵ An advocacy coalition consists of a set of actors who share a set of basic beliefs and values (policy goals). The actors within a coalition are affiliated with a variety of public and private institutions but collectively seek to manipulate the rules, budgets, and personnel of governmental institutions to achieve their own coalition’s policy goals over time. Actors in a coalition are unified with the intent to address specific issue(s) or aspect(s) of an issue but can differ significantly in the contents of their moral, cultural, and ideological baggage. Sabatier (1999: 133) refers to this baggage as the “Belief System of the Policy Elites”. A belief system comprises a deep core, a policy core, and secondary aspects. *Deep core* is defined as fundamental normative and ontological axioms that run through all policy subsystems. Changes in the deep core are very difficult and akin to “a religious conversion”. To demonstrate, it would be extremely difficult to convince a Hindu member of an anti-hunger coalition in India that consumption of beef should be considered as means to significantly alleviate food shortage problems. It would be similarly unlikely for a member of an anti-poverty coalition belonging to upper echelons of the status quo to forgo the material comforts of life in the developed world to alleviate poverty problems in developing countries.

The *policy core* is subsystem wide. Policy core comprises fundamental policy positions concerning the basic strategies for achieving core values within the subsystem. Changes in the policy core are difficult but more likely than changes in the deep core. Examples include understanding of cause-effect relationships and policy preferences. Secondary aspects refer to instrumental decisions and information searches necessary to implement policy core. *Secondary aspects* are associated with parts of the subsystem and are moderately easy to change. Examples include perceptions of seriousness of specific aspects of a problem in a specific locale and importance of various causal linkages in different locales and over time. Changes in secondary aspects are the focus for most administrative and legislative policy-making. Based on this categorization of the “Belief System”, Sabatier and Jenkins-Smith (1993, 1999) describe (policy) change as being a function of three sets of processes. The first concerns the interaction of competing advocacy coalitions within a policy subsystem. Second, changes external to the policy subsystem under study (i.e., changes to the socio-economic conditions, system-wide governing coalitions, and output from other subsystems) provide opportunities and obstacles to competing actors. Third, there are relatively stable system parameters, e.g., social culture, basic distribution of resources, constitutional rules, which determine the constraints and resources of the various subsystem actors.

The ACF is concerned with examining changes in the belief systems of policy actors over the long-term; the dynamics of advocacy coalition formation and stability of policy subsystems; the role of factors, actors, or events exogenous to the policy subsystem in changing the belief system; and the conditions under which policy

⁵ The policy subsystem, area, or domain as described by Sabatier and Jenkins-Smith (1993, 1999) is analogous to Ostrom’s (1999) “action arena”.

learning occurs across coalitions of the policy subsystem. The framework is based on five premises:

- The availability, diffusion, absorption, and utilization of information-in-context is instrumental in the policy process and policy change;
- To account for learning and changes in actors' belief systems, a period of a decade or longer needs to be examined to understand the process of policy change;
- The most useful unit of analysis in policy analysis is a policy subsystem (or domain), consisting of actors from a variety of public and private organizations, concerned with an issue, and actively seeking to influence public policy in that domain;
- The policy subsystem should include actors from all levels of government (governance), administrative agencies, legislative committees, interest groups, journalists, researchers, and policy analysts;
- Theories, implicit or explicit, underlie perceptions of a problem and how to address it. Theories determine value priorities, perceptions of important causal relationships, perception of world states, and perceptions or assumptions about the efficacy of various policy instruments.

One of the main advantages of the ACF over Ostrom's (1999) IAD is that the ACF pays much closer attention to the evolutionary dynamics of change in policy and institutional arrangements and underlines the role of learning within and among advocacy coalitions. The IAD and ACF are both useful for describing how change does or might occur without making sufficient provisions to specify "why". The question of why policy and institutional change occur is more extensively addressed through the "Policy Streams Approach", discussed next.

2.4 Policy Streams Approach

The starting point for Kingdon's (1984) "Policy Streams Approach" (PSA) is that in the policy process one encounters "considerable doses of messiness, accident, fortuitous coupling, and dumb luck". However, despite a certain degree of unpredictability it would be "a grave mistake to conclude that [policy processes] are essentially random" (Kingdon 1995:206). The PSA resolves to understand why participants in a policy process deal with certain issues and neglect others. The emphasis is thus placed on agenda setting and alternative specification (Kingdon 1995, John 1998, Zahariadis 1999). PSA draws on earlier works on bounded rationality to explain ("irrational") individual behaviour in light of new information, systems approaches to recognize the complexity that results from the interaction among numerous endogenous and exogenous factors, chaos theory to account for a significant degree of randomness, and punctuated equilibria to denote the continuous and evolutionary characteristics of the policy process.

Whereas Sabatier and Jenkins-Smith (1993, 1999) refer to "complicated situations" to describe the policy process, Kingdon expands on Cohen, March and Olsen's (1972) "garbage can theory" to articulate "messiness" as the defining characteristic. Messiness is a product of the pulls and pushes of endogenous and exogenous factors, participants not knowing or adequately articulating what they want, and time

constraints forcing instant, often unclear, decisions. Other factors such as lack of knowledge about the roles of others in the same situation, unclear jurisdictional boundaries, lack of top-down and bottom-up systems of accountability, and turf battles further intensify the messiness of the policy process while creating an operational environment prone to trial-and-error procedures as indispensable learning tools (Zahariadis 1999). That certain issues are attended to instead of or prior to others is “a function of opportunity, bias, formal position in an organization or government, and the number of issues competing for policymakers’ attention” (March and Romelaer 1976, cited in Zahariadis 1999:76).

The PSA focuses on “agenda setting” and “alternative specification” as “predecision” processes. Agenda setting narrows down the range of objectives for decision makers for practical reasons. Agenda objectives are set based on problems requiring policy-makers’ attention. Problems are brought to the attention of policy-makers by political activists and interest group lobbyists. Numerous people participate in the policy-making process including presidents and prime ministers, members of parliament, civil servants, lobbyists, journalists, and academics. All or some of these participants drive the processes for problem recognition, proposal formation, and politics. Agenda objectives can contain numerous specialized agendas within them. In the policy-making process some specialized agenda items gain prominence and are attended to while others are neglected. Key to understanding the causes of this ongoing selection process is finding out “who affects agendas and alternatives, and why they do” (Kingdon 1995:196). The context for the policy process is defined by the three streams of problems, policies, and politics, each with its own process.

Problems come to the attention of decision makers through indicators, e.g., incidence of a disease or high costs of a programme; “focusing event”, e.g., a disaster, crisis, personal experience, or powerful symbol; and feedback on programme performance or public complaints about a specific issue. Following problem identification, certain approaches gain ascendancy over others. The selection of alternatives to meet *policy* objective is directly related to the actions of “policy entrepreneurs” who “invest considerable resources bringing their conception of problems to officials’ attention, and trying to convince them to see problems their way” (Kingdon 1995:198). *Politics* represent another stream in the PSA. This stream has its own set of dynamics including political events, elections, changes in the public mood and of dominant ideologies, and the activities and tactics of interest groups to press for certain policy directions. The politics stream also defines the mood to fund or withdraw funds from certain programmes. In a democracy agreements in the politics stream are built through bargaining. However, the confluence of the national mood and election results often proves formidable in deciding and setting the agenda.

Once the agenda has been set “alternatives, proposals, and solutions are generated in communities of specialists ...[including] academics, researchers, consultants, career bureaucrats, congressional staffers, and analysts who work for interest groups” (Kingdon 1995:200). Communities of specialists form loosely knit communities made up of people with diverse interests spread across a wide range of organizations and institutions. Specialist community members often only share their specialization and

acquaintance with the issues in a particular policy area.⁶ The *policy stream* is characterized as a selection process in a “primeval soup... [where] many ideas float around, bumping into one another, encountering new ideas, and forming combinations and recombinations”. Through the selection process certain order and patterns develop based on technical feasibility, congruence with the values of community members, and the anticipation of future constraints, including a budget constraint, public acceptability, and politicians’ receptivity (Kingdon 1995:200).

From time to time, the problem, policy, and politics streams are joined together as a result of “an open window of opportunity”, e.g., a significant change in the government or a new problem that can be matched with an existing proposed solution. Joining occurs in the main by policy entrepreneurs “in and around government [who] keep their proposals and their problems at hand, waiting for these opportunities to occur” (Kingdon 1995:203). Windows of opportunity can open unexpectedly or predictably but are always small, scarce, and short-lived.⁷ Policy entrepreneurs strive to “couple” their solution to problems and politics that may be floating in the primeval soup, “knowing that the chances for enactment are considerably enhanced if they can complete the circle [linking problem, policy, and politics]” (page 204) or take advantage of a “lock-in”. An open window may result from the culmination of path-dependent, historical developments, or co-developments. Windows may also become manifest as a result of “cumulative causation”, which is closely associated with the better-known economic concept, the multiplier effect. Open window may also result from random events.

The two main characteristics of the PSA are the focus on the political (in the broadest sense) dimensions of policy making and the explicitly systems-based view of the policy process. The PSA seems to go further than the IAD and the ACF in explaining why some policy objectives are adopted while others are dropped and why certain measures are implemented while others remain on the drawing board. Perhaps because of its decidedly exploratory and mostly inductive approach, the PSA methodology and methods are readily generalizable across a variety of policy domains or other subsystems.

2.5 Synthesis

Table 3 summarizes the main characteristics of the analytical frameworks reviewed above. Institutional analysis requires considerable simplification of the inherent complexities of the policy realm. Among other functions, a framework should simplify the messiness that characterizes the policy arena / domain / subsystem to facilitate in-depth analysis. Simplification is carried out for different frameworks based on a series of assumptions or foci. The intent of this summary table is to allow comparison of the main underlying assumptions.

⁶ Sabatier and Jenkins-Smith (1993, 1999) use the term “advocacy coalitions” to refer to the identifiable presence of specialist communities in the policy subsystem.

⁷ “Short-lived”, if not interpreted in evolutionary terms, is inconsistent with the notion of “lock-in”. See, for example, Liebowitz and Margolis (1995) in footnote 2.

TABLE 3

The choice of framework for institutional analysis depends on the purpose of the analysis being conducted. For example, Hayden's "Social Fabric Matrix (SFM)" is quite useful as a means to identify the main actors and map the inter-relations among them in a given subsystem, or even to determine the boundaries of a subsystem based on inter-relations among entities.⁸ Elinor Ostrom's "Institutional Analysis and Development" (IAD) framework seems to satisfy many of the concerns raised by Nelson and Sampat (2001) and Scott (2001) as it focuses on *how* "the game" is played, paying attention to action arenas where actors and action situations generate quite specific patterns of interaction and outcome. The politics of the policy process are most explicitly explored through Sabatier and Jenkins-Smith's (1993, 1999) "Advocacy Coalition Framework" (ACF) and Kingdon's (1984 [1995]) "policy streams approach" (PSA). To varying degrees the ACF and the PSA focus on causal relationships between key variables to explain "why" certain policy outcomes occur and how the policy subsystem evolves over time.

To varying degrees the approaches summarized in table 3 underline the inseparability of governance and institutional analysis by drawing attention to the formal and informal structures that constitute the governance dynamics of a given subsystem. To capture this link explicitly, we might state that governance consists of the formal and informal institutional devices through which political and economic actors organize and manage their interdependencies. Interdependencies can arise in individual-to-individual, individual-to-firm, firm-to-firm, firm-to-state, and state-to-state relations. Governance structures organize negotiation processes, set standards, perform allocative functions, monitor compliance, reduce conflict, and resolve disputes among actors (Eden and Hampson 1997: 362) to establish stable regimes of accumulation, a necessary condition for a transition to be firmly instituted. As such, governance structures work through socio-economic, political, and ecological systems to determine the nature of inter-relations (based on interdependencies) at the individual, intra- and inter-organizational, and societal levels. In light of this complexity the next section rearticulates the concept of transitions, or technological regime shifts, from a systems perspective to make a case for investigating transitions as multi-level, multi-scale, and multi-system phenomena best understood in their institutional contexts.

3. Transitions and Institutional Analysis

The concept of transition is firmly rooted in the development of complex systems (Nicolis and Prigogine 1977, 1989) according to which under certain conditions, open systems with a gradient across their boundaries will move away from equilibrium and will establish new stable structures (Kay 1991). The development of complex systems is characterized by phases of rapid organization leading to steady states, which after a period of relative calm tend to lose their stability and move toward rapid reorganization to constitute a new steady state. The organization / disorganization / reorganization process that characterizes a given (sub)system may be continuous or catastrophic but is in both cases evolutionary in that at no time all total system

⁸ See, for example, Munkirs (1985).

components are “stationary”. In addition, each new state has elements or remnants of past states and thus there are no entirely “new” states. Some steady states may be more stable than others, however. A transition is thus said to occur when a new (significantly different) dynamic equilibrium is reached (Rotmans, Kemp, and van Asselt 2001). The occurrence of a transition should be traceable to a series of inter-related institutional changes.

A societal transition usually takes 25 years or longer and results from a coming together of a set of developments in different domains to constitute a new end state significantly different from the previous state(s). The process of change is non-linear, analogous to the development of Kay’s (1991) “thermodynamic branch”. The path in figure 2A depicts a subsystem that develops along a thermodynamic branch toward an “optimum operating point” where the organizing and disorganizing forces neutralize each other. Changes in the total system cause a movement from the steady state operating point to a new optimum operating point (figure 1B, 2). This is equivalent to moving to an earlier, less stable, “successional” stage. In figure 2B, the subsystem is more volatile at point 2 than at point 1. If this new balance is further disturbed, due to additional changes in the larger system, for example, the subsystem can move away, through a bifurcation, from the original thermodynamic branch onto a new branch and onto a new optimum operating point (figure 1C, 3). Kay (1991) refers to these transitions as “flips” in the system.

FIGURE 1

Rotmans et al. (2001) hypothesize that transitions consist of the following stages:

- A predevelopment phase of dynamic equilibrium where the status quo does not visibly change.
- A take-off phase where the process of change gets under way because the state of the system begins to shift.
- A breakthrough phase where visible structural changes take place through an accumulation of socio-cultural, economic, ecological and institutional changes that react to each other. During the acceleration phase, there are collective learning processes, diffusion and embedding processes.
- A stabilization phase where the speed of social change decreases and a new dynamic equilibrium is reached.

In the predevelopment phase structures, routines, and repetitions characterize the subsystem and provide a certain degree of predictability of events. The onset of change is evidenced through the occurrence of unprecedented events, a weakening of existing structures, and decreased repetition. The emergence and establishment of new structures and routines mark the beginnings of a new institutional order closely associated with a new stable dynamic equilibrium. These phases are fully consistent with the development of “thermodynamic branches” (figure 1). A transition may be said to have fully occurred every time an optimum operating point is instituted in the subsystem. The subsystem may be an ecosystem (Kay 1991, 1994), a policy domain,

or a system of production.⁹ The evolution of a subsystem can be traced by using the transition / non-equilibrium thermodynamic framework. Both methodologies draw substantially on complex systems analysis and evolutionary biology. Similarly, evolutionary economists view economic change as the outcome of processes of variation and selection in which there is heredity and recombination of technologies, ideas, practices, routines, structures, organizations, and institutions. Technical advances or transitions are part of trajectories and practices that are embedded and reproduced in social (sub)systems.

FIGURE 2

The adoption by existing systems and organizations of innovations and new technology can sometimes result in dramatic changes in the total system. It has to be noted that change, however fundamental, can often be related to a previous path and a specific set of variables. For example, Kemp et al. (1994) define a technological regime¹⁰ as the complex consisting of the following variables: scientific knowledge, engineering practices, production process technologies, product characteristics, user practices, skills and procedures, institutions, and infrastructure. Similarly, Rip and Kemp (1998) define a technological regime as the grammar, or rule-set, embedded in the coherent complex of a technology (or mode of manufacturing), which structures the search activities of engineers and the policies and actions of other technology actors (including public authorities). Changes in one or more of the variables that constitute the technological regime could result in a movement between optimum operating points within the subsystem (technological regime).

Transformation from one optimum operating point to the next is often the product of the co-evolution of a set of slow changes, the changes in system factors (variables) that determine the undercurrent for a fundamental change. Superimposed on this undercurrent are events such as calamities that might, under certain conditions, accelerate the transformation process. A transition may be accelerated by one-time events, such as a war or large accidents, e.g., Chernobyl, or a crisis, e.g., the 1970s energy crisis. Larger system changes often cause disturbances at the subsystem scale and could result in a bifurcation (figure 1C). The frameworks summarized in table 3 may be used to identify the key factors whose convergence might have resulted in transitions as manifested in a subsystem, e.g., the Dutch waste management or the Swedish mobile telecommunication subsystems. The ACF and PSA approaches can be used to “simplify” the complicated institutional and organizational landscape by identifying actors based primarily on their association with an advocacy coalition (ACF) or a “stream” (PSA) in a given subsystem.

The ACF treats the institutional affiliation of the actors as a secondary consideration in explaining the dynamics of change in the policy subsystem while the PSA

⁹ In this paper metaphors and examples drawn from biology and ecology are used insofar as they deepen appreciation and understanding of socio-economic complexities. This selective utilization of other disciplines is consistent with Nelson and Winter’s (1982:11) “Lamarchian” approach.

¹⁰ Here, a technological regime is the optimum operating point in the domain, or subsystem, where the technology, or set of technologies, is being used.

submerges institutions into the problem, policy, and politics streams. Neither of these two approaches is explicit on the role played by institutions in defining what occurs in a subsystem. A major part of institutional analysis should be concerned with identifying the multiplicity of institutions that *regulate* what occurs in a given subsystem at different levels of inter-relation. This is depicted in the column headed “Direction of Régulation” in table 4. Positive and negative feedback through inter-relations exist between all elements in the third column of this table. From an evolutionary, dialectical perspective the feedback loops are best described by the “cause-effect-cause” notion whereby a cause is seen to be the product of a previous, related effect. The direction of each the arrows indicates the sequence in the Cause-Effect-Cause continuum. Table 4 is intended to provide a loose but necessary structure to identify and categorize institutions. The task of institutional analysis should begin with finding empirical examples for the institution types listed in table 4. The resulting inventory should facilitate establishing linkages between different types of institution within the subsystem under study. The inventory will also allow examining the manner in which the identified institutions “mature” and transform into other institutions.

TABLE 4

For example, business networks are usually characterized by certain values and codes of conduct. If the network persists over time the members of the network internalize some of the values and most, if not all, of the codes of conduct become predictable routines. The internalization process occurs concurrently with the emergence of new or reinforced behavioural traits among the network members. Depending on the balance of power within the system of governance (among other factors) the business network may succeed in effecting societal change. At this point the network may be thought of as both “associative” for its network characteristics and “constitutive” for its ability to institutionalize at a societal level its values and codes of conduct. The evolution and blending of institutional forms define the conditions underlying the “transaction” between two or more wills in the economic system as they affect the acts of giving, taking, persuading, coercing, defrauding, commanding, obeying, competing, and governing (Commons 1950).

Institutions thus shape transactions among economic agents and are best viewed as multifaceted, durable but evolving social structures, made up of symbolic elements, social activities, and material resources. Institutions spread across systems, e.g., socio-economic, political, and ecological systems; operate at all scales of governance, e.g., local, provincial, national; and define inter-relations at all levels, i.e., the individual, organizational, institutional, and societal. Key to evolutionary institutional analysis is the identification of institution types and their role in effecting movement from one period of stability to the next. The typology in table 4 should be used to arrange the institutions of a subsystem into manageable groups based on their functions and how they facilitate or curtail change within that subsystem.

For a given subsystem long-term belief changes over time need to be identified and documented. To remain within the realm of the widely accepted scientific approach,

the data may be used to test hypotheses based on Sabatier and Jenkins-Smith's (1993, 1999) work and other policy studies. Another possibility is to adopt a post-disciplinary and inductive approach.¹¹ In either case, the questions to be addressed must concern the dynamics of coalition formation and stability, the extent to which beliefs and strategies change over time and why, the role of exogenous and endogenous factors or "events" in the evolution of the subsystem, and the conditions that generate policy-oriented learning within and across coalitions of the same subsystem to result in transitions. Apart from the in-depth review of secondary data sources, semi-structured interviews should be held with "coalition leaders" or key informants in the subsystem under study. The review of the secondary data can reveal the variables (or "events") of the subsystem and point to well documented belief or value changes over time while interviews with key informants can be expected to illuminate the dynamics of change in key variables and the more subtle details of how a transition becomes firmly instituted.

From a policy perspective, effecting change is contingent on the degree of control by change implementers on the most significant variables. A key component of action-oriented institutional analysis is thus to identify the most significant variables of the subsystem. Factors (variables) instrumental in effecting a transition are best characterized as multi-system, multi-scale, and multi-level. To do meaningful institutional analysis of transitions and to investigate context steering opportunities in relation to "desirable" outcomes this complexity needs to be simplified considerably.¹² Findings from conducting analyses of transitions need not fit neatly into the "S" curve shape in figure 3. Indeed because the notion of transitions remains at the conceptual stage, evolutionary institutional analysis should be used to test the validity of the "S" curve hypothesis.

Transitions become apparent when one compares different periods of stability through historical accounts accompanied with quantitative empirical data. Following Sabatier and Jenkins-Smith (1999) the proposed analytical framework views the Dutch waste management arena as a subsystem so as to make explicit account of interdependencies and interconnections. The waste management subsystem is viewed much in the same way as Kingdon (1984) viewed the aviation industry in the United States, for example. That is, this research will be concerned with identifying problems, policies, and politics to explain when, how, and why significant changes have occurred in the Dutch waste management subsystem over time. The increased knowledge on the dynamics of change is expected to increase understanding of the interplays between institutional dynamics and transitions and should offer much in the way of learning for policy-making purposes and for further research into how and why transitions occur.

¹¹ Much has been written about the merits / demerits of inductive and deductive approaches. The methodological approach proposed here is a "hybrid" that leans rather more toward the inductive end of the inductive / deductive spectrum. See Parto (2003b) and Parto and Doloreux (2003) for applications of this approach.

¹² However, simplifications must be rigorously reviewed and reassessed to avoid redundancy of assumptions and to ensure sound analysis.

In identifying and documenting transitions, the proposed framework pays particular attention to the processes of change in the primary, secondary, and tertiary belief system values of the subsystem's actors. *Primary* belief system variables span within and outside the subsystem and are the most difficult to change. Examples include religious or ethnic beliefs on fundamental issues such as human domination over nature or equity and equality. *Secondary* variables are subsystem specific and concern the strategies for addressing the shared problem. Secondary variables may be expressed as ideological positions on strategy and policy instruments, e.g., government regulation versus voluntary self-regulation, to address the shared problem. *Tertiary* variables are associated with the technical and administrative parts of the subsystem. That is, tertiary variables are concerned with how strategies are implemented. As such tertiary variables are continually tested, debated, and thus prone to change more easily and frequently than primary and secondary belief system variables.¹³ Changes in the primary, secondary, and tertiary variables are directly traceable to changes in different types of institution as defined in table 4.

To illustrate, learning from the trials and errors of policy implementation to address groundwater contamination continually presents the subsystem actors with opportunities to learn, debate, and potentially change opinions. A change of approach in policy implementation based on new learning represents a tertiary variable change and may affect secondary variables. The secondary variables may change in response to learning that self-regulation by industry to protect groundwater does not in fact work and is prone to abuse by free-riders. A change in the secondary variables within the subsystem may be to agree to constrain water-polluting activities through legislation. Such a constraint does not question the supremacy of the market or put environmental protection before economic gain. Over sufficiently long periods of time and accompanied with technological advances, secondary variable changes could be reversed in light of new information or raise questions about deeply held beliefs (primary variables) such as the legitimacy of human domination over the natural environment. In the case of the Dutch waste management subsystem the task then is to establish what changes over time and in which primary, secondary, and tertiary variables preceded the shifts in the technological regime.

An important part of studying transitions is forming intuition based on studying historical accounts of developments in a given subsystem. A cursory overview of the Dutch waste management subsystem since 1900 reveals at least two transitions and the beginnings of a third one. The first transition signalled a move from unregulated handling of waste to centralized systems of collection and disposal. This transition was to a significant degree facilitated through a massive state sponsored construction programme to prepare the infrastructure for handling the collected waste, accompanied with new rules, forms, and norms. The first transition stabilized between the 1920s and the 1960s. The second transition began in the 1970s and was to a large extent related to widespread concerns about the state of the environment. This transition was characterized by a move from centralized *disposal* to central

¹³ Primary, secondary, and tertiary belief system values are almost identical to Sabatier and Jenkins-Smith's (1999) "deep core", "policy core", and "secondary aspects", respectively. The definitions used here also draw on Ostrom's (1999) "rules" (mutually understood shared prescriptions on must, must not, and may), "norms" (mutually enforced shared prescriptions), and "strategies" (regularized plans by individuals within the structure of incentives produced by rules, norms, and expectations of others).

management of waste and was preceded and accompanied by significant changes in production and consumption patterns. The stabilization period for the second transition seems to have commenced in the late 1970s and ended by the mid 1990s. It may be suggested that a third transition, or a period of turbulence preceding a new transition, may have started in the early 1990s. The evidence includes new EU directives on waste management, a significant drop in the total volume of non-separated household waste from the peak 1995 level, doubts about the health effects of incinerating waste, and the “entrepreneurial” drive to take advantage of weakly regulated waste management subsystems of the former eastern bloc countries as cost effective alternatives to managing wastes domestically.

The evolution of the Dutch waste management subsystem can be described in terms of changes in the behaviour of agents (reflected in a change in tertiary variables in the waste subsystem) and in the structure of the political economy (reflecting a change in the secondary variables). One may also underline changes in perceptions of waste, emergence of mental (cognitive institutions) models and laws (regulative institutions) on how to deal with waste, changes in behaviour by individuals and organizations to act more responsibly toward waste (behavioural and constitutive institutions), and the stratification of public and private actors through the formation of alliances and interest groups (associative institutions).

Thus, researching transitions has to focus on discovering events, inter-relations, phenomena, or situations as they occur over time in a reasonably well defined subsystem. The limitations of the methodology thus far presented are directly dependent on the manner in which the enquiry is conducted and determined by how the researcher thinks and operates based on political conviction, philosophical orientation, and (concrete and discrete) technical abilities (Greene and Caracelli 1996). Political convictions determine the implicit or explicit value-based purpose of conducting research while the philosophical orientation determines which paradigm(s) and methods are drawn upon to conduct an inquiry. Regardless of political convictions and philosophical orientation, the effectiveness of various field methods (e.g., surveys, interviews, document reviews, time-series comparisons, measurements) depends, among other factors, on the ability of the researcher to apply them (Hessler 1997). Personal skills, social setting, level of trust, and even the ideological climate can and do advance or curtail obtaining reliable research data. Personal or professional relations with the subject of study could also determine research strategy and outcomes.

The next section illustrates how the proposed framework to study transitions may be operationalized to identify the key variables and the conditions whose convergence might have resulted in transitions in the Dutch waste management subsystem.

4. Institutions and Variables of the Dutch Waste Management Subsystem¹⁴

Based on what has been described thus far, the evolution of the Dutch waste management subsystem can be traced to changes in institutions over time. It is also possible to account for changes in the tertiary, secondary, and primary variables of the subsystem. The task of identifying the subsystem's institutions requires grouping the institutions according to the typology in table 4. The grouping of institutions under Associative, Behavioural, Cognitive, Constitutive, and Regulative types allows close examination of how institutions evolve over time. In some cases it is possible to trace the evolution of one institutional form to another. For example, a mental model (a cognitive institution) on waste hierarchy emerged as the Lansink's Memorandum in 1979. An institutionalization process characterized by public information initiatives, financial incentives, structural change, and legislation led to the transformation of the Memorandum to an elaborate business model (a constitutive institution) and widely adopted by industry in the 1980s.

TABLE 5

Hence, rather than showing how institutions are created, table 5 should serve to demonstrate how, once in existence, institutions evolve over time to regulate economic activity. Key to understanding why transitions occur is to identify the key institutions that come into existence, change in response to, and/or reflect (and deflect) the impact of identifiable "events" such as the energy shortage or groundwater contamination issues in the 1970s, significant changes in production and consumption patterns, and the emergence of liberalized markets in the 1980s. These events have acted as triggers and/or catalysts for a series of institutionalization processes that have evolved over time to mutate into additional institutions to structure inter-relations at different levels. Phenomena such as the Lansink's Ladder simultaneously structure inter-relations at the individual, intra- and inter-organizational, and societal levels, for example. Perceived in this manner, the evolution of the Dutch waste management subsystem may be described in cause-effect-cause terms as follows.

Over time the Dutch waste management subsystem has been subjected to a series of endogenous and exogenous "events". An *Event* is defined as the combined impact of one or more dependent or independent *and* endogenous or exogenous variable(s). Once occurred, an event may set in motion and catalyze a series of institutionalization processes resulting in the emergence of distinct and identifiable institution types as exemplified in table 5. An event may be the product of one or more of the following variables:

- Government Legal Act *
- Government Policy *
- Regulation
- Ordinance
- Educational and/or public relations initiatives

¹⁴ This section has benefited from numerous exchanges with Abraham Garcia, René Kemp, and Derk Loorbach.

- Emergence of Covenants (rise of voluntary initiatives and carrot & stick inducement technique)
- Emergence and identification of new problems (e.g., the air pollution / health effects of incineration, dioxin contamination)
- Milestone events such as formation of alliances to demand, or respond to, regulations and ordinances by various stakeholders (NGOs, larger community, firms, unions, EU, etc.)
- Market evolution, e.g., development of new waste product niches; changed consumption and production patterns; market liberalization
- Emergence of new technology developed for or adopted by the waste management subsystem
- Emergence of new knowledge about waste from waste-related and independent research conducted by research and academic institutions (on the health impacts of waste management practices, for example)
- Other

Significance for each Event could be calculated based on the weights associated with that Event. In the following categories, higher weight values indicate higher degrees of importance:

- *Scale* (geopolitical, e.g., municipal, provincial, national, continental, international). Each scale is given a number. The weight of 1 may be attributed to municipal, 2 to provincial, and so on. If a national Event applies at the provincial and municipal jurisdictions, the values for municipal, provincial, and are added up to make up the weight for Scale.
- *Scope* (the range and types of waste covered). Each waste type is attributed a number based on the volume, the socio-environmental impacts, and ability to prevent adverse impacts. We may attribute the following weights:
 - Packaging Waste = 1
 - Solid Waste (Industrial) = 2
 - Solid Waste (Households) = 3

Where there is more than one waste type the attributed numbers for each waste are added up to make up the weight for scope.

- *Citation* in other “Events” (including other regulations). Citation could be determined based on the intuition of key informants and described within the range:
 - Never (value=1)
 - Rarely (value=2)
 - Sometimes (value=3)
 - Almost Always (value=4)
 - Always (value=5)
- *Longevity* (of event). This could be described with ranges, e.g.:
 - 1-5 years (value=1)
 - 6-10 years (value=2)
 - 11-15 years (value=3)
 - etc.

Significance is calculated by multiplying the weights:

$$\text{Significance of Event} = \text{Scale} \times \text{Scope} \times \text{Citation} \times \text{Longevity}^{15}$$

Attributing a numerical value for Significance to each Event allows for ranking the Events in order of importance. The Events with the highest Significance may be said to be the most important variables in the waste management subsystem. The top 4 or 5 Events may then be selected for further observation to determine whether or not changes in the value of one or more of the Events are of consequence in the evolution of the subsystem.

The top 4 or 5 Events may also be used to run different scenarios by altering the Significance attributed to each Event – perhaps to find out which Event(s) help stabilize a transition and which prolong the developmental stages. Running different scenarios could reveal the key Events. The identification of key Events is expected to serve the policy decision-making process.

Density of Events is the sum of the numerical values that denote the Significance of each Event at a point in time. For time periods 1, 2, and t , **Total Density** (TD) is calculated as follows:

$$\begin{aligned} \text{TD}_1 &= S_1 + S_2 + S_3 + \dots + S_n \\ \text{TD}_2 &= S_{n+1} + S_{n+2} + S_{n+3} + \dots + S_{n+m} \\ \text{TD}_t &= [\dots] + S_q \end{aligned}$$

Where q represents the Significance of the last event counted for period t .

The impact of Events diminishes over time. To reflect this, a discount rate should be applied to the Total Density of a given period in each subsequent period. The discount rate applied should in addition reflect subsystem specifics and peculiarities.

Cumulative Total Density (CTD) is calculated by adding the (discounted) Total Density values over time:

$$\text{CTD}_t = \sum_{i=1}^{i=t} \text{TD}_i (1 - \delta)^{i-1} \quad \text{where } \delta \text{ is the discount rate.}$$

CTD over time may be charted to determine whether and how it corresponds with the intuitively determined transition phases of predevelopment, take-off, acceleration, and stabilization. This exercise would allow for “testing” the transition hypothesis in the waste management subsystem. The methodology described here does carry a heavy burden of subjectivity. Grounding this methodology requires careful examination of historical data in waste management including the volumes of waste generated, recycling, and incineration, for example, and their relationships with the changes in such variables as the GDP or consumption patterns. Accompanied with the corresponding Cumulative Total Density trend, the charting of quantitative historical

¹⁵ If the numbers representing Significance of Events are too large, a geometric average may be used.

data can demonstrate how, as well as why, the waste management subsystem has evolved in the manner it has in the Netherlands.

5. Conclusion

Institutional configurations should be viewed as nested, hierarchical structures that evolve over time and in response to the impact of endogenous and endogenous variables. Certainly, meaningful institutional analysis requires making simplifications and assumptions regarding the endogenous and exogenous factors that affect the phenomenon or situation under study. The frameworks discussed in this paper, as well as the framework offered for evolutionary institutional analysis in the preceding section, all make such simplifications. Key to assessing the usefulness of an analytical framework is ensuring that the assumptions remain valid and adequate throughout the analysis. Thus the assumptions and simplifications that underlie the proposed framework need to be continuously and rigorously reviewed after each case study and revised as and when necessary to reflect subsystem specific peculiarities.

This paper has been concerned with understanding how and why transitions occur and what the implications are for policy-making. From a systems perspective it can be argued that transitions in a subsystem occur as a result of the co-evolution of a set of slow subsystem changes over time coinciding with significant endogenous and exogenous events. Key to understanding the dynamics of such changes are the institutions through which events are embedded and which regulate inter-relations at different levels. Given the centrality of institutions in determining the evolutionary path of the economic activity, it is of crucial importance to capture the multiplicity of institutional forms that result from the confluence of endogenous/exogenous variables *and* the already existing institutions within a recognizable frame of reference and to determine the levels at which these institutions operate.

A typology of institutions is suggested here as a loose but structured means of compiling an inventory of institutions for the subsystem under study. This typology is to be used in conjunction with a methodology to rank events which bear upon the subsystem and transform many of institutions, while creating new ones, and strengthening others. The proposed framework allows for investigating the links between the evolution of the subsystem's institutions over time in response to the occurrence of endogenous and exogenous events of varying importance. The methodology in addition calls for attributing quantified significance levels to events so as to isolate the key variables of the subsystem and to establish the extent to which these variables may be controlled.¹⁶

¹⁶ The framework presented in this paper is currently being applied to the Dutch waste management, the Swedish mobile telecommunication, and the European pulp and paper subsystems.

TABLES

Table 1. Social Fabric Matrix

	Receiving Component						
Delivering Component	Cultural Value 1...n	Social Belief 1...n	Pers. Attitude 1...n	Personal Taste 1...n	Environment 1...n	Technology 1...n	Institutions 1...n
Cultural Value 1...n							
Social Belief 1...n							
Pers. Attitude 1...n							
Personal Taste 1...n							
Environment 1...n							
Technology 1...n							
Institutions 1...n							

Source: After Hayden 1993

Table 2. Examples of Components and Elements

Component	Elements
Cultural Values	Domination of nature by humans, atomistic conceptualization, extensive hierarchical relationships, (Newtonian concept of) flowing time, divine creation, dualistic thought, dynamic expansiveness
Social Beliefs	Statutes, agency rules, regulations, operation procedures, work ethics, property rights, compassion, redistribution, reciprocity, exchange
Personal Attitudes	Frugality, communitarianism, racism, consumerism, environmentalism; anti-environmentalism
Personal Tastes	Preference based on fashion, gender, class
Natural Environment	Air, water, soil, flora and fauna
Technology	Tools, skills, knowledge
Social Institutions	Kinship, marriage, habits, rules, courts, government and its agencies, industry and its agencies, interest groups, religions, market, money,

Table 3. “Simplification” of the Policy Process for Institutional Analysis

Analytical Framework	Main Characteristics
Institutional Rational Choice¹ (including IAD)	<ul style="list-style-type: none"> ● Institutions are viewed as “constraints” on the exercise of choice – the range and number of available choices are determined by the institutional context, e.g., voting rules, committee procedures, rewards and punishments ● Focus is on leaders of a few critical institutions with formal decision making authority ● “Leaders” pursue their own material self-interest ● Actors can be grouped into a few institutional categories
Advocacy Coalition Framework²	<ul style="list-style-type: none"> ● Belief systems are more important than institutional affiliation ● Actors “learn” and periodically change their belief systems and revise strategies ● Actors may be pursuing a variety of objectives ● Researchers and journalists (in addition to politicians, bureaucrats, and citizens groups) are potentially significant policy actors ● Changes in the core aspects of a policy are usually the results of changes in non-cognitive factors external to the policy subsystem, e.g., the macro-economic or political conditions ● The policy process has to be studied over a period of a decade or longer
Policy Streams Approach³	<ul style="list-style-type: none"> ● “Messiness” of the policy process is taken as the baseline ● “Policy formation” and change are products of a coming together of problems, policies, politics, and random events creating opportunities for new ideas ● “Policies” are proposed and lobbied for by “policy entrepreneurs”, e.g., politicians, bureaucrats, analysts, consultants, journalists, and academics. ● “Politics” are political processes such as elections and their aftermaths or the role of “regulatory” factors, e.g., pressure groups, in agenda formation, awareness raising, and learning.
Institutional Analysis and Development Framework⁴	<ul style="list-style-type: none"> ● “Physical / material conditions”, “Attributes of Community”, and “Rules-in-Use” constitute the starting point in the analysis ● “Action Arena” is the unit of analysis, consisting of “action situations”, e.g., an environmental problem, and “actors” (individuals and organizations) ● Individuals are “fallible learners” capable of making mistakes and learning ● Learning depends on the availability of incentives and opportunities in “institutional arrangements” ● “Patterns of Interactions” among actors of an action situation generate “outcomes” whose evaluation against predetermined societal criteria provides feedback for the various stages of the policy process
Network Analysis / Social Fabric Matrix⁵	<ul style="list-style-type: none"> ● Focus on (formal and informal) relationships among decision makers within the same policy domains ● Networks exist either, to build relationships for mutual advantage (Helco 1978), or to act as coordinative device for the policy domain to respond to change and to resist or co-opt destabilizing demands (Browne 1995) ● Networks may be “mapped” to highlight the key nodes (Hayden 1998) ● Density and resilience of relationships within a network may be measured to postulate on the behaviour of the network and its members

¹ Shepsle (1989); Scharpf (1997); Ostrom (1986, 1990); ² Sabatier and Jenkins-Smith (1993, 1999); ³ Kingdon (1995 [1984]); John (1998); ⁴ Ostrom (1999); ⁵ Hayden (1982a,b,c; 1993; 1998)

Table 4. Types of Institution

Institution Type	Examples	Direction of Régulation
Associative: Institutions as mechanisms facilitating prescribed or privileged interaction among different private and public interests	Business Networks; Kinship Groups; Social Classes; Associations; Interest Groups	Member ↔ Member
Behavioural: Institutions as standardized (recognizable) social habits – manifested in activities of individuals and groups as reflections of widely accepted and expected social norms	Habits; Routines; Ways of Doing Things; Shared Beliefs; Theories in Use	Individual → Society Groups → Society
Cognitive: Institutions as mental models and constructs or definitions – manifested primarily in what society expects of individuals or groups	Deeply held Cultural and Social Values; Perceptions of Good and Bad; Superstitions; Wisdom	Individual ← Society Groups ← Society
Constitutive: Institutions setting the bounds of social relations through systems of coercion and sanction	Collective Actions initiated by the State Agencies, Firms, Unions, or Citizens Groups; Language; Property Rights Structures; Agreements; Arrangements; Marriage	Individuals ↔ Individuals and Groups ↔ Groups
Regulative: Institutions as prescriptions and proscriptions to constitute new social relations	Written and Unwritten “Rules of the Game”; State as Rule Maker, Referee, and Enforcer	Society and State ↓ Individuals and Groups

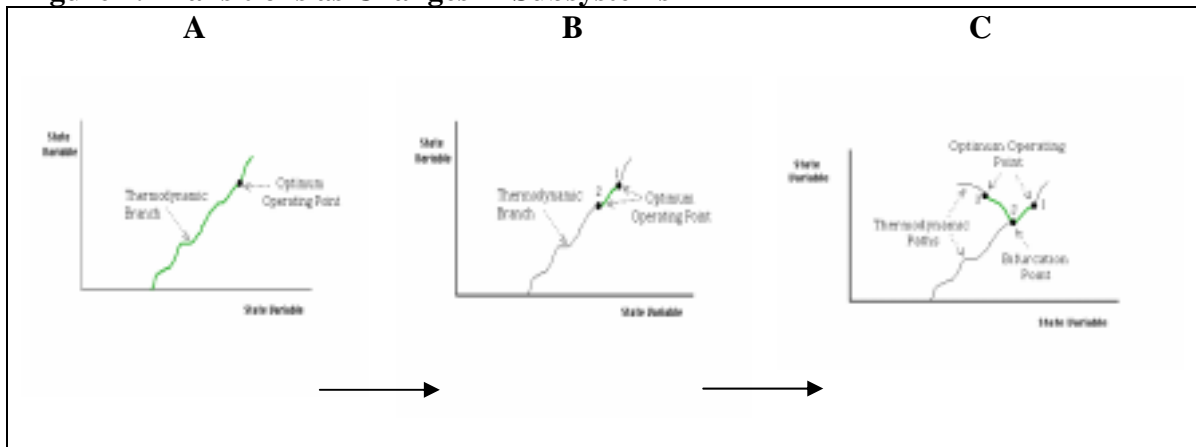
Adapted from Parto (2003a)

Table 5. Institutions of the Dutch Waste Management Subsystem

Institution Type	Catalyst Event	Direction of Régulation
Associative: Institutions as mechanisms facilitating prescribed or privileged interaction among different private and public interests	Policy networks around air and water issues (1970s-present); Citizens’ and Producers’ networks to define waste management policy on packaging, collecting, separating, recycling, incineration, and landfilling	Member ↔ Member
Behavioural: Institutions as standardized (recognizable) social habits – manifested in activities of individuals and groups as reflections of widely accepted and expected social norms	Recycling and domestic and industrial waste separation by individuals or groups of individuals (1970s-present)	Individual → Society Groups → Society
Cognitive: Institutions as mental models and constructs or definitions – manifested primarily in what society expects of individuals or groups	Liberalized markets (1980s); Formalized Producer responsibility (1990s); Lansink’s Memorandum (1979)	Individual ← Society Groups ← Society
Constitutive: Institutions as entities setting the bounds of social relations through systems of coercion and sanction	Governmental environmental departments (1970s); Organizational waste management divisions (1980s); NMP+ (1980s, 1990s, 2000); Lansink’s Ladder (1980s); Environmental audits (1990s); Liberalized waste markets (1990s); Formalized Producer responsibility (1999); National Waste Plan (2000)	Individuals ↔ Individuals and Groups ↔ Groups
Regulative: Institutions as prescriptions and proscriptions to constitute new social relations	Surface water and air pollution legislation (1970s); Covenants (1980s, 1990s); Incineration guidelines (1980s)	Society and State ↓ Individuals and Groups

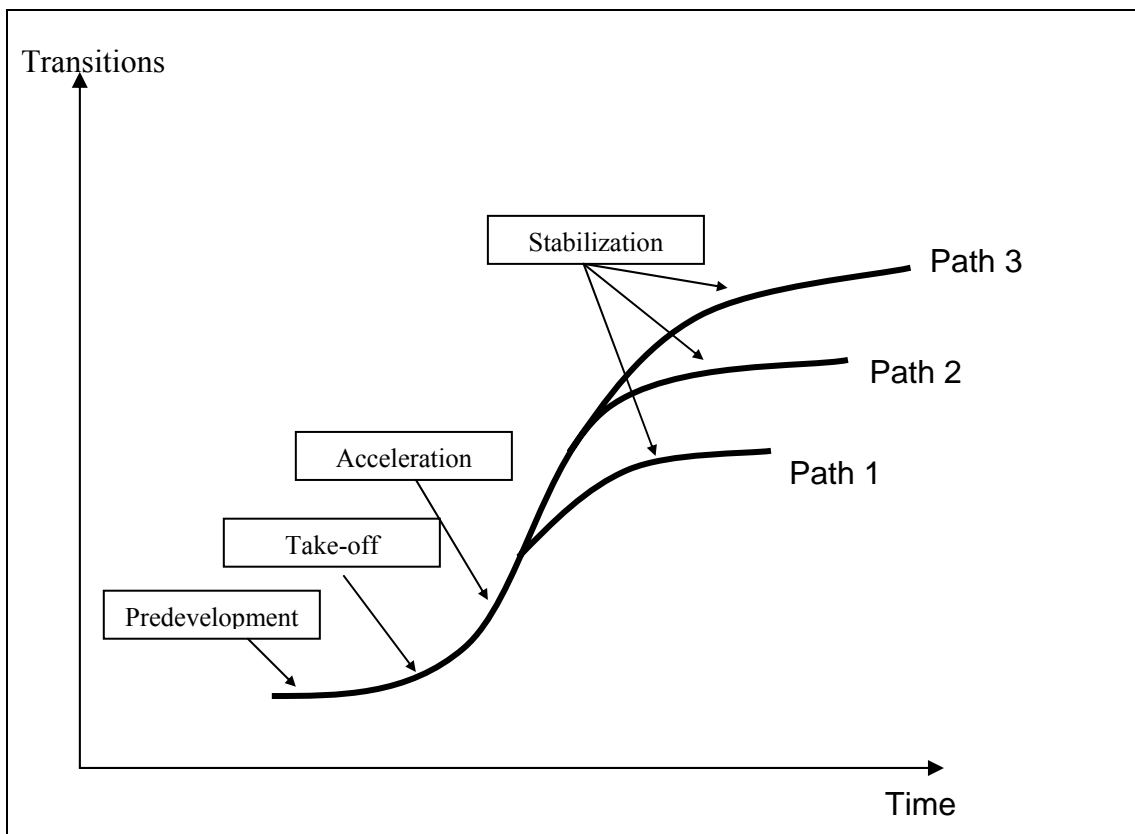
FIGURES

Figure 1. Transitions as Changes in Subsystems



Adopted from Kay (1991)

Figure 2. Phases of Transitions



Adapted from Rotmans, Kemp, and van Asselt (2001)

References

- Arthur, B. (1990). "Positive Feedbacks in the Economy," Scientific American 262 (February): 92-99
- Barley, S.R. and P.S. Tolbert (1997). "Institutionalization and Structuration: Studying the Links Between Action and Institution", Organization Studies 18: 93-117
- Bill, J.A. and R.L. Hargrave, Jr. (1981). Comparative Policy: The Quest for Theory (Washington, DC: Bell & Howell, University Press of America)
- Brenner, N. (1998). "Between Fixity and Motion: Accumulation, Territorial Organization and the Historical Geography of Spatial Scales." Environment and Planning D: Society and Space 16(1): 459-481
- Boyer, R. (1979). "Wage Formation in Historical Perspective: The French Experience". Cambridge Journal of Economics. 3, 99-118
- Bush, P.D. (1987). "The Theory of Institutional Change". Journal of Economic Issues. 21 (September), pp. 1075-1116.
- Commons, J.R. (1950). The Economics of Collective Action (Madison: University of Wisconsin Press)
- Dewey, J. (1954). The Public and its Problems (Chicago: The Swallow Press).
- DiMaagio, P.F. (1988). "Interest and Agency in Institutional Theory", in L.G. Zucker (ed.) Institutional Patterns and Organizations: Culture and Environment (Cambridge, MA: Ballinger), pp. 3-21
- Dunford, M. (1990). "Theories of Regulation". Environment and Planning D: Society and Space 8:3, 297-321
- Eckstein, H. (1963). "A Perspective on Comparative Politics, Past and Present", in Eckstein, H. and D.E. Apter (eds.) Comparative Politics (New York: Free Press of Glencoe), pp. 3-32
- Eden, L. and F.O. Hampson (1997). "Clubs are Trumps: The Formation of International Regimes in the Absence of a Hegemon", in Hollingsworth, J. and R. Boyer (eds.) Contemporary Capitalism: The Embeddedness of Institutions. (Cambridge, England: Cambridge University Press), 361-394
- Foster, J.F. (1981a). "Syllabus for Problems of Modern Society: The Theory of Institutional Adjustment". Journal of Economic Issues. 15 (4), 929-35.
- Foster, J.F. (1981b). "The Fundamental Principles of Economics". Journal of Economic Issues. 15 (4), 937-42.
- Granovetter, M. (1985). "Economic Action and Social Structure". American Journal of Sociology, 91:3, 481-510.
- Hall, R.H. (1992). "Taking Things a Bit Too Far: Some Problems with Emergent Institutional Theory", in K. Kelly (ed.) Issues, Theory, and Research in Industrial Organizational Psychology (Amsterdam: Elsevier), pp. 71-87
- Hayden, F.G. (1982a). "Project Evaluation in a Futures Real Time System." Journal of Economic Issues 16 (2), pp. 401-11.
- Hayden, F.G. (1982b). "Social Fabric Matrix: From Perspective to Analytical Tool." Journal of Economic Issues. 16 (3), pp. 637-61.
- Hayden, F.G. (1982c). "Organizing Policy Research Through the Social Fabric Matrix: A Boolean Digraph Approach." Journal of Economic Issues. 16 (4), pp. 1013-26.

- Hayden, F.G. (1987). "Evolution of Time Constructs and Their Impact on Socioeconomic Planning." Journal of Economic Issues. 21 (3), pp. 1281-1312.
- Hayden, F.G. (1991). "Instrumental Valuation Indicators for Natural Resources and Ecosystems" Journal of Economic Issues. 24 (4), pp. 917-35.
- Hayden, F.G. (1993). "Institutionalist Policymaking", in Tool, M.R. (ed.) Institutional Economics: Theory, Method, Policy (Norwell, MA: Kluwer Academic Publishers), pp. 283-331.
- Hayden, F.G. (1994). "Institutional Theory and Public Policy", in Hodgson, G.M., W.J. Samuels, and M.R. Tool (eds.) The Elgar Companion to Institutional and Evolutionary Economics (Aldershot: Edward Elgar Publishing Limited), pp.392-397.
- Hayden, F.G. (1998). "Normative Analysis of Instituted Processes", in Fayazmanesh, S. and M.R. Tool (eds.) Institutionalist Theory and Applications: Essays in Honour of Paul Dale Bush (Cheltenham, UK: Edward Elgar Publishing Limited), pp. 89-107.
- Hayden, F.G. and K. Stephenson (1992). "Overlap of Organizations: Corporate Transorganization and Veblen's Thesis on Higher Education" Journal of Economic Issues. 26 (1), pp. 53-85.
- Hirsch, P.M. (1997). "Review Essay: Sociology Without Social Structure: Neoinstitutional Theory Meets Brave New World" American Journal of Sociology 21:1702-23
- Hodgson, G. M. (1988). Economics and Institutions: A Manifesto for a Modern Institutional Economic. (Cambridge: Polity Press).
- Hodgson, G. M. (1993). Economics and Evolution: Bringing Life Back into Economics. (Ann Arbor: University of Michigan Press)
- Hodgson, G. M. (1999). Economics and Eutopia: Why the learning economy is not the end of history. (London: Routledge).
- Hollingsworth, J. and R. Boyer (1997), eds. Contemporary Capitalism: The Embeddedness of Institutions. (Cambridge, England: Cambridge University Press).
- Jessop, B. (1997). "The Governance of Complexity and the Complexity of Governance: Preliminary Remarks on Some Problems and Limits of Economic Guidance", in Amin, A. and J. Hausner (eds.) Beyond Market and Hierarchy: Interactive Governance and Social Complexity (Cheltenham, UK: Edward Elgar), pp. 95-128
- John, "P. (1998). Analyzing Public Policy (London: Pinter)
- Kay, J.J. (1991). "A Non-equilibrium Thermodynamic Framework for Discussing Ecosystem Integrity", Environmental Management, 15 (4): 483-495
- Kay, J.J. (1994). "Some notes on: The Ecosystem Approach, Ecosystem and Complex Systems and State of the Environment Reporting", (Waterloo, ON: University of Waterloo)
- Kingdon, J. (1984[1995]). Agendas, Alternatives, and Public Policies (Boston: Little, Brown).
- Kemp, R. (1994). "Technology and the Transition to Environmental Sustainability: The Problem of Technological Regime Shifts", Futures 26(10): 1023-1046
- Kemp, R., J. Schot, and R. Hoogma (1998). "Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management". Technology analysis and strategic management 10 : 175-196
- Liebowitz, S.J. and S.E. Margolis (1995). "Path Dependence, Lock-In, and History." Journal of Law, Economics and Organization 11: 205-226

- March, J.G. and P.J. Romelaer (1976). "Position and Presence in the Drift of Decision", in J.G. March and J.P. Olsen (eds.), Ambiguity and Choice in Organizations (Bergen, Norway: Universitetsforlaget), 251-276.
- Mattessich, R. (1978). Instrumental Reasoning and Systems Methodology: An Epistemology of the Applied and Social Sciences (Dordrecht, the Netherlands: D. Reidel Publishing Co.).
- Munkirs, J.R. (1985). The Transformation of American Capitalism: From Competitive Market Structures to Centralized Private Sector Planning, (Armonk, NY: M.E. Sharpe)
- Myrdal, G. (1957). Economic Theory and Underdeveloped Regions. (London: Duckworth)
- Neale, W.C. (1987). "Institutions". Journal of Economic Issues. 21 (3): 1177-1206
- Nelson, R. R. (1995). "Recent Evolutionary Theorizing About Economic Change". Journal of Economic Literature. 33:1, 48-90.
- Nelson, R.R. and Sampat, B.N. (2001), "Making Sense of Institutions as a Factor Shaping Economic Performance", Journal of Economic Behavior and Organization 44:31-54
- Nicolis, G. and I. Prigogine (1977). Self-Organization in Non-equilibrium Systems, (New York: John Wiley and Sons)
- Nicolis, G. and I. Prigogine (1989). Exploring Complexity, (New York: W.H. Freeman)
- North, D. (1990). Institutions, Institutional Change, and Economic Performance (New York: Cambridge University Press).
- Oliver, C. (1991). "Strategic Responses to Institutional Processes". Academy of Management Review 16:145-79
- Ostrom, E. (1986). "An Agenda for the Study of Institutions". Public Choice, 48 3-25
- Ostrom, E. (1990). Governing the Commons, (Cambridge, England: Cambridge University Press)
- Ostrom, E. (1999), "Institutional Rational Choice: An Assessment of the Institutional Analysis", in Sabatier, P.A. (ed.) Theories of the Policy Process (Boulder CO: Westview Press), pp. 35-73
- Parto, S. (2003a). "Economic Activity and Institutions: Taking Stock", MERIT-Infonomics Research Memorandum Series (2003-007).
- Parto, S. (2003b). "Sustainability and the Local Scale: Squaring the Peg?", MERIT-Infonomics Research Memorandum Series (2003-0017).
- Parto, S. and D. Doloreux (2003). "Public Policy and Sustainable Development: Agenda (21) for Change?", MERIT-Infonomics Research Memorandum Series (2003-018).
- Perrow, C. (1961). "The Analysis of Goals in Complex Organizations". American Sociological Review 26: 151-55
- Polanyi, K. (1957). "The Economy as Instituted Process", in Polanyi, K., C.M. Arensberg, and H.W. Pearson (eds.). Trade and Market in the Early Empires (Chicago: Henry Regnery)
- Rip, A. and R. Kemp (1998). "Technological Change", in Rayner, S. and E.L. Malone (Eds.), Human Choice and Climate Change, (Columbus, Ohio: Battelle Press), 327-399
- Rotmans, J., R. Kemp, and M. van Asselt (2001). "More evolution than revolution: Transition management in public policy." The Journal of Futures Studies, Strategic Thinking and Policy. 3:15-31
- Sabatier, P.A. and H.C. Jenkins-Smith (1993) eds. Policy Change and Learning: An Advocacy Coalition Approach (Boulder CO: Westview Press).

- Sabatier, P.A. and H.C. Jenkins-Smith (1999). Frameworks Focusing on Policy Change over Fairly Long Periods”, in Sabatier, P.A. (ed.), Theories of the Policy Process. (Boulder CO: Westview Press).
- Sayer, A. (1999). "Long Live Postdisciplinary Studies! Sociology and the curse of disciplinary parochialism/imperialism" (draft). Department of Sociology, Lancaster University, at: [<http://www.comp.lancs.ac.uk/sociology/soc025as.html>].
- Scharf, F. (1997). Games Policy Actors Play. (Boulder, CO: Westview Press).
- Scott, W.R. (2001). Institutions and Organizations, 2nd edition, (London: Sage Publications).
- Scott, W.R., M. Ruef, P.J. Mendel, and C.A. Caronna (2000). Institutional Change and Healthcare Organizations: From Professional Dominance to Managed Care (Chicago: University of Chicago Press).
- Shepsle, K.A. (1989). “Studying Institutions: Some Lessons from the Rational Choice Approach”. Journal of Theoretical Politics, 1, 131-149
- Stinchcombe, A.L. (1968). “Social Structures and Organizations”, in March, J.G. (ed.) Handbook of Organizations (Chicago: Rand McNally), pp. 142-93
- Stinchcombe, A.L. (1997). “On the Virtues of Old Institutionalism”, Annual Review of Sociology 23:1-18
- Street, J. (1987). “The Institutional Theory of Economic Development”. Journal of Economic Issues 21 (4): 1861-1887.
- Swaney, M.R. (1987). “Elements of a Neoinstitutional Environmental Economics”. Journal of Economic Issues, 21 (4)
- Tickell, A. and J. Peck (1992). “Accumulation, regulation and the geographies of post-Fordism: missing links in regulationist research.” Progress in Human Geography 16(2): 190-218
- Tool, M.R. (1994). “Instrumental Value Theory”, in Hodgson, G.M., W.J. Samuels, and M.R. Tool (eds.) The Elgar Companion to Institutional and Evolutionary Economics (Aldershot: Edward Elgar Publishing Limited), pp.406-411.
- Veblen, T.B. (1899). The Theory of the Leisure Class: An Economic Study of Institutions (New York: Macmillan).
- Williamson, O. E. (1985). The Economic Institutions of Capitalism. (New York, The Free Press)
- Weir, M. (1992). "Ideas and the Politics of Bounded Innovation”, in Structuring Politics: Historical Institutionalism in Comparative Analysis Steinmo, S., K. Thelen, and F. Longstreth (Cambridge: Cambridge University Press).
- Zahariadis, N. (1999). “Alternative Views of the Role of Rationality in the Policy Process”, in Sabatier, P.A. (ed.) (1999). Theories of the Policy Process. (Boulder CO: Westview Press).