Matching Planning Styles and Roles in Transportation to Conditions of Uncertainty and State of Technological Know-How

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In the process of transportation planning, the planning need be conducted not just within the limits of the rational planning model, but in the context of planning styles that match the type and characteristics of the system, as well as the degree of uncertainty involved in the process. There are three interdependent key variables: (a) the means (technologies); (b) the ends (goals and objectives); and (c) the degree of uncertainty attached to the means and ends. Three levels of the state of the technological know-how—that is, known, developing, and unknown—are considered and connected with three degrees of uncertainty attached to the goals and objectives of a planning agency. This connection results in a matrix of nine cells, each representing a particular type of planning problem, matching a unique planning style or a combination of planning styles. An agenda for action is proposed to aid the planner in selecting an appropriate planning style.

Most countries in the developed and developing world are currently identifying future directions for conducting transportation planning. In the United States, for example, the 2020 Transportation Consensus Program, initiated by AASHTO in collaboration with other organizations, is attempting to determine the nation's surface transportation requirements over the next 30 years (*1*). Recognition of the importance of innovation and new technology in such diverse fields as vehicular navigation, control and location, robotic systems and automation, real-time control, artificial vision, and logistics and communication science results in a great deal of enthusiasm in adopting these technological innovations. However, comparatively little has been discussed as far as planning, evaluating, and implementing these advanced technologies within the framework of current planning organizations. One of the key characteristics of the future is that planners will have to grapple with uncertainty in dealing with not only new, unproven, and uncertain technology, but also with highly complex organizations having fuzzy goals and objectives.

This paper deals with three interdependent key variables—means, ends, and degree of uncertainty. If we consider three levels of the state of technological know-how—that is, known, developing, and unknown—and connect these three levels with three degrees of uncertainty attached to the goals and objectives of a planning agency, we end up with a matrix connecting the means or the state of technological know-how with ends or goals adopted by an agency, resulting in a typology of nine cells, each representing a particular type of planning problem and needing a unique planning style or a combination of planning styles.

To grapple with these uncertainties, urban transportation planning in the future will tend to be conducted in the context beyond the limits of the rational planning model (RPM), a style widely used by transportation engineers and planners over the last 30 years (see Figure 1). This means that to effect plans planners will adopt the following planning styles and roles: incremental, transactive, advocacy, radical, and reflective, among others. Such styles and roles will probably be defined by planners themselves or by society at large. In any case, as the planning process grows more complex, active citizen participation will be essential, if only to ensure that bureaucracies are responsive to the public they serve. This paper describes and discusses the possibility of adapting appropriate planning styles and roles in transportation planning.

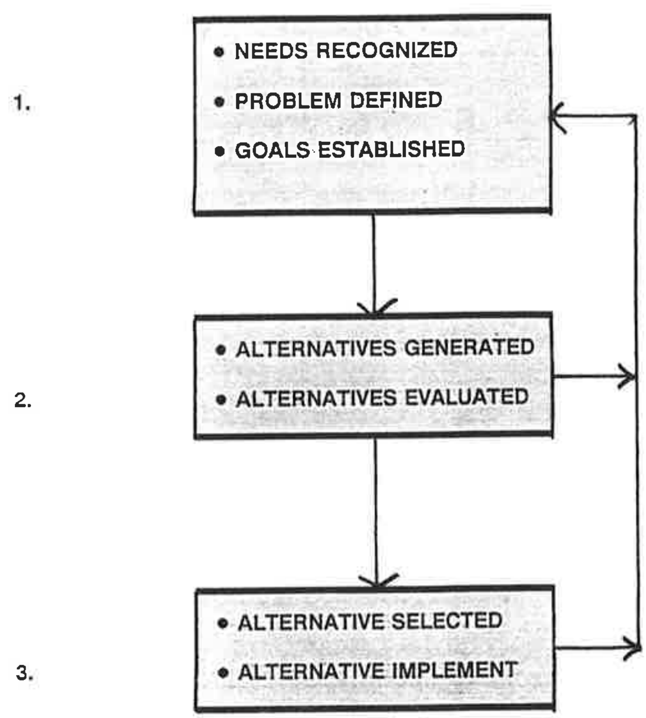

FIGURE 1 RPM.

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NATURE OF TRANSPORTATION TECHNOLOGY: PLANNING PROCESS

Profound advances in transportation engineering technology have occurred in the last decade, and these advances continue unabated. Adopting, adapting, extending, and refining these new technologies in current planning and engineering practice is no easy task. Since a great deal of transportation planning is concerned with the medium- and long-range future, it is characterized by a high level of uncertainty. Almost all transportation facilities are capital-intensive and, once built, are not easily amenable to major changes and rebuilding without enormous expenditure and disruption. What do these basic facts mean in terms of planning for the future?

One of the most fundamental tasks is to discover, assess, and address this uncertainty. However, the issues and problems faced by transportation planning agencies appear to defy resolution with the help of the decisions, tools, and traditional planning techniques that have been developed over the past 40 years. These techniques were designed primarily to solve problems in which both ends and means were pretty well known. This inherited professional legacy that attempts to address almost all planning problems by means of the RPM has led to serious dilemmas in recent years (*2–4*). Given the great complexities that face planners and decision makers, particularly now effective planning and evaluation can best be undertaken if planners and decision makers are aware of a variety of planning theories and corresponding planning styles to address a range of uncertainties occurring in the adoption of new technologies.

Transportation systems continually present critical problems long before these systems actually break down or lose their capacity to serve the goals and objectives they were meant to satisfy. Naturally, the conceptualization, research, development, planning, and selection of alternatives required to meet the needs of today and the future must be projected on the basis of several factors, one of the most important of which is time. Although many hundreds of amazing innovations will become available in the future, the questions that continuously arise are, Which ones are proven and well established? Which ones are currently considered to be operationally practical for adoption? Which ones are technologically feasible? and, Which ones are glamorous and exotic yet conceptual and therefore unproven? (*5*). As stated earlier, the high investment in transportation facilities tends to make adoption of technology a slow and incremental process.

In summary, transportation planning problems, as they appear today, are highly complex, conflictual, and interconnected, involving multiple perspectives and assumptions. They can never be solved, as some planners believe, but possibly may be resolved following the "law of the indestructibility of wicked problems."

APPROPRIATE STYLES OF PLANNING: TECHNOLOGICAL KNOW-HOW

Although the RPM is the most favored and common process adopted by transportation planners, this style of planning has led to ineffective results, particularly when means and ends are poorly defined. Many other planning theories and corresponding planning styles can deal with various degrees of uncertainty (*4*). Unfortunately, transportation planners have discussed little about alternative planning styles to deal with uncertainty, and transportation agencies have not tried to adopt planning styles other than the RPM.

	OBJECTIVES		
STATE OF KNOWLEDGE	SINGLE AGREED	MULTIPLE AGREED	NOT AGREED
KNOWN	A	B	C
DEVELOPING	D	E	F
UNKNOWN	G	H	I

FIGURE 2 Matrix connecting state of technological knowledge and goals adopted by agency.

There has always been uncertainty and ambiguity over means and ends in real life. According to Christensen, the key variables that prompt the planner to adopt a particular style of planning are means, ends, and degree of uncertainty (*6*). A matrix connecting the state of technological knowledge (means) and the goals adopted by an agency (ends) was developed on the basis of this idea (Figure 2). Each dimension is further subdivided according to the degree of certainty or uncertainty. Obviously, no real-life problem can be exactly placed in a particular cell created by this matrix for the simple reason that technology itself is value laden and goals can be biased by the technologies adopted. Thus, the matrix consists of nine cells, and there are several grey areas at the boundaries of these cells. A description of each cell follows.

Cell A—Known Technology, Agreed Goals or Single Goal

When a planning agency agrees on what it wants (through public representation), and the technology to achieve this goal exists, then it is possible that a fair amount of certainty prevails and the RPM can be applied through standard, routine procedures. The U.S. military procurement program is an appropriate example (*4*). It uses the latest analytical techniques, resulting in a high degree of formal rationality. Another major application of the RPM is found in municipal planning and engineering work, such as replacing a stop-sign–controlled intersection with a signal. Despite its elegance and simplicity, the RPM has been criticized by various quarters and for myriad reasons. Limits to rationality, methodology, and professional expertise are some of the important ones (*7*).

On the plus side, the RPM, which requires a known technology (means) and an agreed goal (end), is predictable, accountable, efficient, and effective, although it may often be bureaucratic.

Cell B—Known Technology, Multiple Agreed Goals

Cell B represents a pretty common situation faced by planners in which the technology is known and the public has accepted a battery of goals that are not necessarily compatible with one another. The conditions in this case are not as clear-cut as those in Cell A but certainly not as ambiguous as when the goals are not agreed on (Cell C). What one observes therefore is a case of "bounded" rationality, as suggested by Simon (*8*). He emphasized the fact that decision makers can never be completely rational in the sense of having total knowledge of a situation and the alternatives available to them, nor do they have the time, resources, and intelligence to sort out the consequences of the multiple objectives adopted by the public. Under the circumstances, the best one could do was not to seek optimization, but simply to manage to "satisfy" major organizational values; to satisfy was all that one could reasonably expect within the limitations prescribed. In other words the course of action would be one that appeared to be good enough; the first and perhaps not the least important action would be to apply the test of common sense. Simon was convinced that the choice among alternatives is simplified if we replace the goal of maximizing (or optimizing) with the goal of satisfying (*9*).

Cell C—Known Technology, No Agreed Goals

The Cell C situation, frequently encountered, is one in which proven methods are available but the public has not agreed on the goals. For example, a city may have just the right population density for introducing a light-rail system with the technology for adopting light rail, but the city may not have goals, thus precluding the adoption of this proposed light-rail system over an extended portion of the city.

One way out of such a situation is through a bargaining process. Consensus building can be established through communication, particularly for those communities that seem to hold out against continuous rail lines through their turf. Bargaining in any case is difficult because it goes against the very principles of bureaucracy. Consensus building can be crucially important, partly guided from above by controlling societal groups and partly voluntaristic (*10*). This process could also be considered as "interwoven planning" embracing the twin processes of consensus formation and societal guidance. Here the accommodation of multiple preferences through bargaining seems to be the key issue (*4*).

Cells D and E—Developing Technology, Simple or Multiple Goals

Cells D and E represent the case in which the technology is developing and the public has agreed on single or multiple goals. The general approach to these two boxes would call for the planner to work through trial and error, trying something, receiving feedback, and making modifications and adjustments until the situation became acceptable.

Incremental planning as suggested by Lindblom (*11,12*) attempts to achieve this kind of adjustment, adopting decision-making strategies to the limited cognitive capacities of decision makers. Some of the major characteristics of incrementalism are that only a few alternatives are considered and that only a few consequences are considered and evaluated. Also changes are made in increments, considering that we are trying to shoot a moving target. Lindblom's "muddling through" tactic is most apt.

It would appear at first sight that incrementalism and satisfying are almost the same. However, there is a subtle difference. Although both operate within bounded rationality, incrementalism need not stop short at finding a satisfying solution—it may attempt at optimization within its bounded context. This difference is all the more possible when goals are well defined or when only a single goal is being considered (*9*). The concept of "mixed scanning" as proposed by Etzioni is also appropriate because it synthesizes large (synoptic) and small (incremental) decisions into a single framework. Here, an in-depth investigation of selected problems is done that merits special attention (*10*).

Cell F—Developing Technology, No Agreed Goals

Cell F, although similar in some respects to Cell C, emphasizes uncertainty to a much larger extent because the technology is in the developmental stage. Hence, planners take their clients' points of view and set forth proposals in their clients' interests. Promoting more active and diverse citizen participation could also be considered. In short, this is a case in which advocacy planning could be considered. One consequence of advocacy planning is to shift social policy formulation into the open. It also calls for developing plural plans, involving a host of interest groups. The ideal role of the advocate is to help the client organization clarify its ideas and goals and, thus, plan correctly (*13*).

Cell G—Unknown Technology, Agreed Goals

When there is a commitment on the part of the government to attack a pressing problem but no proven technology is available, experts may try to propose plausible solutions. The immediate problem is to search for the missing knowledge and come up with a technology. A good example is one concerned with mitigating traffic congestion through high technology. Obviously, innovation is needed and hence anything routine or bureaucratic has no place in such a situation. In this case the focus is on methods to generate the necessary knowledge to understand what is truly needed. Experimentation is therefore the name of the game. Such experimentation may lead to innovation. One should be cautious in applying this experimentation or innovation by applying the fuzzy technology in a pilot project, which in itself is not extensive but large enough for figuring out the sensitivity of the various parameters entering the system. Intelligent vehicle navigation systems and artificial vision and logistics are examples of new transportation technology that is available for experimentation and limited use.

Cell H—Unknown Technology, Multiple Goals

The Cell H box resembles that of Cell G, except that its conditions of uncertainty are much more confused and unstable—although certainly not as bad as those in Cell I. To some, this box may represent a case of near chaos, requiring radical means of solving the problem. Indeed, radical planners believe that education should come from the everyday life of local communities—a form of social learning or reflection in action (RIA) popularized by Schön and his colleagues. RIA is an improvisational problem-solving, interactive experimentation undertaken on the spot, using local knowledge. Schön's emphasis is to teach local participants the esoteric skills of "learning to learn." The learning-to-learn paradigm may even result in discovery and innovation and has been put into practice in recent years with much success (*14–16*).

Cell I—Unknown Technology, No Agreed Goals

The Cell I box represents situations that are not uncommon. Goals can be nonexistent or at best nebulous, combined with "solutions" that need a technology that is still unrefined. This situation can be all the more aggravating when an organization, faced with such a dilemma, does not have a leader. In such cases, conditions of uncertainty over both means and ends result invariably in chaos. Rittel and Weber have addressed this and other situations that convincingly explain some of the characteristics of "wicked" problems (*2*).

It is not clear how one could extricate an organization from this chaotic situation. In some cases it may be possible to sift through a bundle of vague goals, a process suggested by Friedman under the heading of "social learning" (*4*). Beginning and ending with action, social learning is a complex, time-dependent process that involves social practice.

DISCUSSION OF RESULTS

The nine cells were adopted for sheer convenience and should not be construed as watertight compartments. Combining planning styles is the answer. Uncertainty appears to be the dominant characteristic facing most planning organizations now and will prevail perhaps more intensively in the future. Depending on the chemistry of the situation, a range of planning-solving approaches and styles needs to be adopted by planners who recognize the difficulty of practicing the rational planning methodology so common over the past decades. The various approaches suggested in the last section envision the planner as neither the pure technician nor the value-free implementor of others' decisions. In fact, the complexity of emerging problems puts transportation planners at the crossroads of engineering, planning, and sociopolitics, and much will therefore depend on their ability to integrate the principles of planning theory in day-to-day practice (*16*).

Radford has suggested four broad specifications for dealing with complex decision making (*17*):

1. The procedure should include the most appropriate characteristics of existing approaches developed in the analytical, behavioral, and political sciences.
2. The process should be readily comprehended by the public.
3. The process should be sufficiently broad based and flexible for application in a wide range of problem situations.
4. The process should be one that can be introduced unobtrusively into an agency, with a minimum amount of disruption.

In recent years planners have made deliberate effort toward development of a "contingency" role in practicing their profession. They have changed their strategies to suit the situation and have realized in no uncertain terms that political concerns generally take precedence over technical concerns for all but the most simple situations (*18*).

Schön's RIA concepts have also gained recognition, particularly in those fuzzy areas of planning in which the situation appears chaotic. Ideas for moving from the hard, high ground of the theorist down to the dark, boggy swamp of the practitioner are gaining momentum (*19*).

In recent years, some radical changes have been initiated by notable planners across the world who are trying to manage problems similar to those that are occurring in transportation planning. Of particular interest is the work of Checkland, whose published literature focuses on the approach to plural rationality through "soft" systems methodology. As opposed to "hard" systems methodology (similar in many respects to RPM), which is used for tackling real-world problems in which an objective or end to be achieved can be taken as given, soft systems methodology, based on a phenomenological stance, tackles real-world problems in which ends that are known to be desirable cannot be taken as given. Checkland's methods have been applied with much success in scores of planning and management situations around the world (*20,21*).

The involvement of citizens in governing society is the subject of history itself. During the past 40 years, the level and effectiveness of citizen participation in the planning process have most often been stimulated and enhanced when existing social problems are complicated and the level of uncertainty is high. Such enhancement is also observed when citizens are skeptical of official solutions. It is therefore anticipated that as the planning process grows more complex, active citizen participation and control will become commonplace, thus ensuring that bureaucracies are responsive to the public they serve. Ultimately, all plans are really political statements; indeed, all attempts to implement them are political acts (*22*).

In closing, a word should be said about evaluating methods. To achieve a high degree of acceptance by the many participants in the planning process, it is suggested that this evaluation process be divided into two basic stages:

1. Modeling of scenarios under various situations, and
2. Assessment of effects and consequences, both tangible and intangible, for a variety of factors using cost-benefit, cost-effectiveness, or utility analysis.

This evaluation is the most important part of the decision process, but it is a topic that should be addressed in a separate paper. Suffice it to say that the multidimensional implications embedded in the decision-making process will be reflected in the selection of the objective functions (*23*).

AGENDA FOR AGENCY BUILDING

If there is one nagging theme that haunts us through our discussion on planning, it is that of rationality. The bottom line is that in attempting to be rational, do we make things better or worse? The complexities of planning forces planners to view problem solving as a process of social interaction, trial and error, successive approximation, and social learning. Such an approach induces planning institutions and agencies to move away from the Weberian model as described by Friedman (*4*).

Under the circumstances it is very likely that transportation planning agencies will be obligated to reconstitute and restructure their organizations to adopt some or all of the following characteristics:

1. *Technical capability:* the ability of agencies to deliver technical services and sift through technological know-how for guiding society regarding technological innovations and possible adoption.
2. *Normative commitment:* the ability of agencies to internalize innovative ideas and practices for the betterment of society.
3. *Environmental image:* the ability of agencies to attain favorable recognition from society, on the condition that they respect environmental concerns when adopting innovative ideas.
4. *Equity concerns:* the ability of agencies to effectively address questions of equity at the micro and macro levels. Distributive justice is as important as the adoption of new technology.
5. *Citizen participation:* the ability to engage the participation of system members in contributing to the collective knowledge of the system. The more complex the problem, the greater is the need for localized solutions and value innovations—both of which call for broadly based citizen involvement in the decision process.
6. *Accountability:* the ability of agencies to recognize that, under conditions of uncertainty, errors and mistakes are not only likely—they are to be expected. The concept of policy making as social experimentation requires that a project be planned and implemented in such a way that errors and mistakes can be uncovered as the project proceeds. It can then be redesigned and revised incrementally. This point is highly significant because planning agencies are notorious for suppressing mistakes and errors, and they have been known to punish managers—sometimes wrongly. Fear of making mistakes discourages correction, redesign, and redirection and inhibits creativity, innovation, flexibility, and experimentation—the very core of successful planning and implementation.

CONCLUSIONS

Traditionally, transportation planning has worked under the assumption that both the technology to be adopted and the goals and objectives set forth by an agency are well known, in which case the RPM is well suited for application. Although this assumption is theoretically true, the real world does not operate so tidily. With the tremendous strides made in almost every area of transportation technology, such as electronic guidance systems, automatic vehicle control, and communication science, transportation planners and decision makers must deal with technology that is constantly in transition. Coupled with this problem is the one connected with goal formation and adoption: uncertainty in both dimensions of the matrix—means and ends—is difficult to comprehend. However, this is a fact that will become more and more prevalent in more and more transportation planning agencies. Planners and decision makers must face this uncertainty by tailoring the planning process according to the degree of uncertainty embedded in the technological knowledge base and the goals adopted.

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