INSTITUTIONAL ANALYSIS OF THE ACCEPTANCE OF PHOTOVOLTAICS IN DAYTIME RADIO BROADCASTING

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THE RADIO BROADCASTING INSTITUTIONAL ARENA

ABSTRACT

This paper, one of a series resulting from institutional analysis of photovoltaic (PV) acceptance, is undertaken in relation to a field test of PV applicability for use by a small-scale daytime AM radio station. Hypotheses in five areas of institutional comprehension of PV as an innovation are proposed. The five areas are: (1) decision structure of the station; (2) technical knowledge of the decision-maker; (3) prior information about solar energy of the decision-maker; (4) image potential of the field test to the station; and (5) financial contribution of the station. In the course of data collection, a sixth area -- the PON-RFP process -- was identified. Thirty-one radio stations which met the requirements for potential test site were studied to determine the institutional factors influencing their disposition to accept PV. The findings reveal a considerable capability on the part of small, daytime radio stations to deal with technologically based information about solar energy, coupled with a strong commitment to the encouragement of its broader use. Many revealed a considerable familiarity with solar energy applications, but did not view its use in their setting as primarily contributing to their station's image. Stations had limited financial resources for participation in the project, but more importantly, were confused about the project's demands on these resources, because of their unfamiliarity with the PON-RFP process. This last finding is an interesting example of how money may be misused as a proxy variable, and how this misuse can be a major barrier to facilitating innovation acceptance.

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This paper is one of a series resulting from institutional analysis of photovoltaic (PV) acceptance. These studies are undertaken with sponsorship of the US Department of Energy (DOE) as part of its PV program. The studies are oriented toward investigating the dynamics of introducing and encouraging the acceptance of a major technological innovation: PV, the direct conversion of sunlight into electricity. In addition to institutional questions, DOE is interested in economic, marketing, and technological issues, and is sponsoring a series of studies and field tests on these topics. Institutional analyses typically have been undertaken in relation to particular PV field tests, although in some cases these studies have focused on comparable technologies and institutional forces influencing their acceptance.

The study of institutional factors influencing the acceptance of PV in daytime radio broadcasting is being conducted in conjunction with Lincoln Laboratory's field test of PV applicability for use by a small scale (250-500 watt) daytime AM radio station. This field test was selected by Lincoln Laboratory for a number of reasons, including:

* power demands are relatively small, thus reducing the size of the solar cell array needed to produce adequate power;
* use time coincides with maximum insolation;
* power demands of transmitting equipment are often for Direct Current, which is what a PV array produces;
* site characteristics (large, open, and relatively remote) of transmitting locations allow generalizability of findings to other remote uses.

As will be discussed in some detail later, this study focuses on individual stations and their decisions about proposing participation as Lincoln Laboratory's field test site. It considers the institutional forces which influence the acceptance and application of a technical innovation.

An institutional analysis involves seven steps (Nutt-Powell et. al., 1978.):

(1) Identify the sector (i.e., economic, geographic) to be studied; determine study objectives.

(2) Prepare a preliminary sector exploration -- i.e., an overview that can be applied to any location-specific sector.

(3) Construct an hypothesized institutional arena.

(4) Identify the "perturbation prompter."

(5) Devise the specific research design.

(6) Monitor perturbation.

(7) Analyze the institutional arena.

The Lincoln Laboratory's selection of daytime radio broadcasting identified the sector to be studied, while DOE's PV program objectives set the parameters for the study of this sector. An earlier paper in this series presents a preliminary sector exploration. (Hendrickson and Nutt-Powell, 1979.) That paper also served as a key reference document in preparing this report; certain material found there has been incorporated here.

In conducting an institutional analysis, one identifies six types of institutional entities -- formal and informal organizations, members, persons, collectivities, and social orders. Institutional action consists of exchanges, in which the critical datum is information. Such exchanges occur within an institutional arena. Innovation forces institutional action by disrupting existing social meaning. (Nutt-Powell et. al., 1978.) This study considers the exchanges of institutional entities in the broadcasting institutional arena, and the nature of their exchanges in response to "perturbations" prompted by Lincoln Laboratory's effort to field-test the applicability of PV in daytime radio broadcasting.

THE BROADCASTING INSTITUTIONAL ARENA

The radio broadcasting industry is significantly focused and centralized at the federal level, especially in terms of political and regulatory functions. As a service function, the industry is highly localized, with individual stations serving a market defined by permissible broadcast patterns (time, geography, signal strength) and desired listener characteristics. At this delivery level there is a mutual dependency between radio stations and advertisers.

Historically, broadcasting is a highly political institutional sector. The level and extent of federal guidance and regulation is substantial; the web of formal and informal connections between and among Congress, the White House, the Federal Communications Commission, the courts, and interest groups (both industry and citizen) is dense. Radio was one of the first industries subject to extensive federal regulation, which is interesting considering the relatively short time between its discovery and its use for private purposes. The first domestic law for general control of radio was passed in 1912. By 1927, the airwaves were so cluttered that Congress was able to pass rather stringent regulatory legislation, which, among other things, created the FCC's predecessor agency, the Federal Radio Commission.

The FCC defines four classes of AM broadcast stations, according to power output, channel of operation, geographic coverage, and hours of operation:

<u>Class I</u> stations operate on "clear" channels -- frequencies set aside by international agreement for use primarily by high-powered stations designed to serve wide areas. These stations usually have 50kw (though never less than 10kw) power, and serve remote rural areas as well as large centers of population. There are only two Class I stations on each clear channel. The US has priority on 45 clear channels.

Class II stations are secondary stations on a clear channel operating at 250w to 50kw power. They serve centers of population and adjacent rural areas. There are 29 channels on which Class II stations may operate.

Class III stations share a "regional" channel with numerous similar stations. Operating at a power from 500w to 5kw, they serve centers of population and adjacent rural areas. There are over 2,000 Class III stations operating on 41 regional channels.

Class IV stations operate on a "local" channel which is shared by many similar stations elsewhere. They usually operate at 1kw during the day and 25w at night. There are six local channels, each occupied by 150 or more stations.

Skywaves are secondary radio waves that are lost in the daylight. However, at night they cover tremendous distances, and stations that do not interfere with others during the day will often interfere with others at night. Therefore, the number of AM stations operating at night must be limited. Slightly more than half of the AM stations in the US are licensed for daytime-only operation (BROADCAST YEARBOOK, 1978). Generally, the higher the permissible power, the clearer the channel, the broader the geographic coverage, and the longer the hours of operation, the more successful the radio station will be.

There are three general task areas of operation for a station: program, engineering and business. Larger stations have several people on staff, each with a defined responsibility typically within only one operations area. At smaller stations, it is more likely that personnel will have several responsibilities, often crossing operations areas.

The regulatory, political, service, and technological attributes of broadcasting provide an interesting pattern of institutional exchanges, especially because the primary commodity of broadcasting is information. Indeed, the general sensitivity of the industry to information, and especially timely information, suggests that the industry would be responsive to knowledge about innovation. Further, the position of radio as a given community's disseminator of information could be extremely advantageous for encouraging innovation acceptance, either by disseminating information about its availability or by adopting it for the station's own use. The high level of competition in areas where there are many stations could contribute to a more rapid spread of a convincing innovation. In areas where there is only one station, on the other hand, this station's predominance as an information source could serve to insure thorough coverage.

The relatively recent history of increased responsiveness on the part of the media to citizen needs and participation is an additional factor contributing to the rapid spread of information. Due to several Supreme Court decisions, which have established that the public has a legitimate voice in the process of licensing stations, the broadcasting industry, more than most industries, has been obligated to consider the concerns and needs of its consumers. In some cases, stations have formal agreements with citizen groups which determine programming priorities and formats. In other instances, station ownership and licensing has been changed as the result of court challenges by dissatisfied listener groups. For these reasons, radio stations are relatively responsive to public interest in issues such as the energy crisis, alternative energy sources, and other contemporary questions.

Radio broadcasting is also a technical industry, and one which (as has been noted) is a fairly recent innovation. Radio stations are operated by engineers and technicians with an interest in technological developments, particularly since radio and broadcasters are continually developing and implementing product innovations (for example, solid state circuitry, which has largely replaced vacuum tubes). This familiarity with and acceptance of rapid technological change makes radio a field which views itself as an innovator.

Though radio is a service activity, with a strong technological orientation and set in a highly regulated political context, it is also a commercial enterprise. As such, it is governed in part by the profit motive, and by free market standards for investment and innovation. Thus, concerns with political and regulatory responsiveness, as well as the technical curiousity of engineering personnel, are weighed against economic realities. Though profit-loss statements are not the only criteria for decisions by radio station operators, they are clearly not unimportant.

The frontispiece of this report portrays diagrammatically the institutional arena of the radio broadcasting industry.

THE PERTURBATION PROMPTER

The perturbation introduced into the institutional arena of daytime radio was Lincoln Laboratory's interest in obtaining a station willing to collaborate as a field test site. An area within which the field test would be located was defined based on insolation and ease of access to Lincoln Laboratory's Lexington, Mass. location. The area included New England, Mid-Atlantic and near Midwest states - i.e., Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Wisconsin, Ohio, Illinois, Michigan, and Indiana.

A selection procedure based on federal procurement practices was devised. In May 12, 1978, Project Opportunity Notices (PONs) were sent to each of the approximately 800 daytime AM stations with power ratings within the 250-500watt range in this area. (The stations were identified using the national small-scale radio guide.) This PON stated briefly that MIT and Lincoln Laboratory were initiating a study of PV equipment to provide a small-scale power supply, and solicited statements of interest and general qualifications from stations which desired to receive the actual Request for Proposal (RFP). Of those receiving the PON, 103 responded, stating interest and providing evidence of general qualifications such as station ownership, size of station-owned land, and geographic position.

Each of the 103 stations received a formal Request for Proposal dated August 1, 1978 and an invitation to a bidders' conference to be held on August 14, 1978. The RFP indicated that there were several conditions attached to participation in the project: (1) willingness to help in the careful collection of technical data to monitor the performance of the PV system: (2) cost-sharing by the station for items not directly connected with the solar system itself (such as housing for the battery array and monitoring equipment, any fencing or other security measures required, etc.); (3) good accessibility and preferably visibility of the station site to the general public and visitors, and willingness to host those who wished to learn about the installation; and (4) technical capability to handle the hook-up between the solar system and the existing radio station equipment.

The RFP emphasized that the project is designed to test questions of technological performance; it is a field test, not a demonstration of commercial feasibility. The matter of project finances as economics is not clearly addressed. Though it noted that Lincoln Laboratory would provide all the equipment necessary for the system, the RFP requires that stations state what costs they could share for other aspects of the project, without indicating any standard as an amount, or importance of cost-sharing in selection of the winning proposal.

In response to its RFP, Lincoln Laboratory received only seven proposals, one of which was received well beyond the September 5, 1979 deadline. This level of response was viewed as surprisingly low and was a matter of concern to Lincoln Laboratory project staff. The proposals received were screened using a specially-developed selection procedure.

One interesting element of the proposal selected was the intention of the station to use a large, well-known manufacturer of telephone switching equipment to design the components necessary to accomplish technical interface between the station's existing equipment and the PV component. The Lincoln Laboratory staff saw an unexpected opportunity to influence a major company in the design, manufacture, and distribution/marketing of components necessary for the ultimate success and acceptance on a widespread scale of PV equipment.

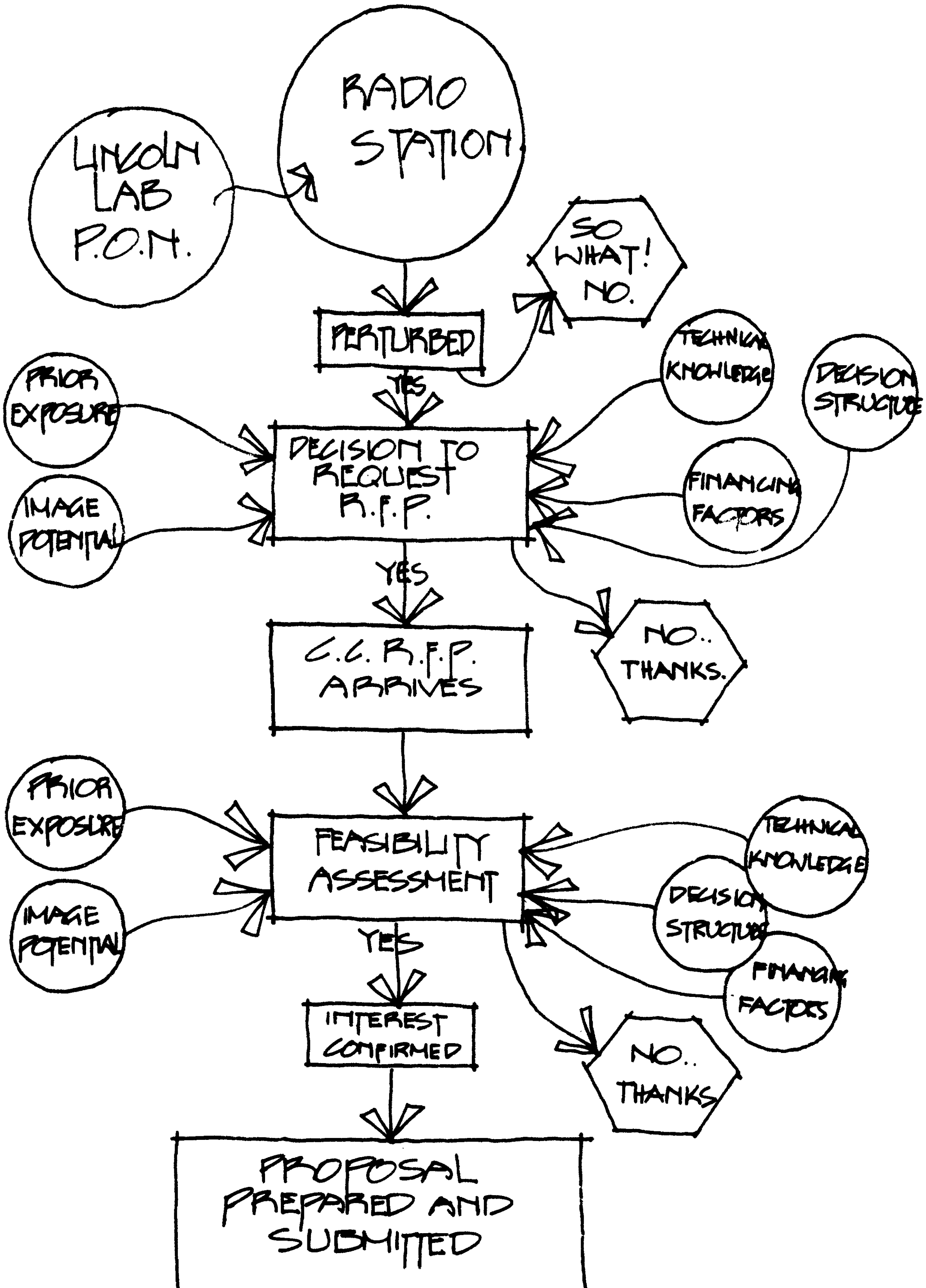

FIGURE 1. OPPORTUNITY FOR INNOVATION

RESEARCH DESIGN

While Lincoln Laboratory's interest in the radio station field test of PV is primarily technological, the institutional investigation is concerned with why the station would decide to be involved in the field test.
As a general approach, institutional analysis hypothesizes that there are a number of institutional forces which contribute to an institutional entity's propensity to accept an innovation. Lincoln Laboratory's PON and RFP served as perturbation prompter for the study. Some 800 daytime AM radio stations in the northeast quadrant of the US had their institutional routines perturbed by Lincoln Laboratory's need to field test PV. How did these stations decide what to do with this information? Why did the 103 stations indicate their interest in the opportunity? Why did only eight stations decide to take the further step of submitting a proposal? What can be learned of institutional dynamics from a perturbation that lead to acceptance of the PV test possibility by only 1% of the radio stations?

The theory of institutional analysis as a means of understanding innovation acceptance suggests that the comprehensibility of the innovation to an institutional entity is central to its propensity to accept it. The information which is transmitted in institutional exchanges is not single-faceted. A single item of information can have many dimensions and many information items are passed in an exchange. The meaning of the information is the consequence of many institutional forces, which can be identified and understood using the methods of institutional analysis. (Nutt-Powell et al, 1978.)

For the study of institutional forces influencing the decisions of the 800+ radio stations in their response to the Lincoln Laboratory perturbation, a set of hypotheses in five areas were developed to guide the specific research design. The five areas were:

(1) Decision structure of the station;

(2) Technical knowledge of the decision-maker;

(3) Prior information about solar energy of the decision-maker;

(4) Image potential of the field test to the station;

(5) Financial contribution of the station.

Decision structure: Stations can have varying staff sizes, and may be operated by the owner, or some other operator. Stations which are managed by a non-owner (often a corporation with several stations) and/or with large staffs are more likely to have complicated channels of information. By comparison, owner-operated stations (often situations of family ownership and operation) and/or those with small staffs are likely to have more direct communications channels. We hypothesized that the more complicated the procedure to reach a decision, the more likely the innovation is to be not comprehended at one or more levels of decision. Any limit on comprehensibility limits the disposition to continue exchanges regarding the innovation.

Technical knowledge: The information contained in Lincoln Laboratory's PON and RFP was primarily technical, focusing on the attributes of PV and the role of the field test in the development of the technology. Moreover, the nature of information to be submitted to Lincoln Laboratory in response to both the PON and the RFP was essentially technical. We hypothesized that there would be a greater likelihood of a positive decision to the extent that the staff involved in making a decision on the perturbation found this technical information comprehensible.

Prior Information: No innovation is encountered entirely *de novo*. There is always some mediation in the encounter with the information on the innovation. At the time of the Lincoln Laboratory perturbation-prompting PON and RFP, PV was a generally unknown technology. Thus we hypothesized that prior information and exposure to the notion of solar energy generically would increase interest in the field test.

Image potential: An important element in capturing a significant share of the potential listening audience is station image. Stations use slogans ("Beautiful music, for you") or contests ("An album to the fifth lucky caller") to develop an identity with a listening audience. Being a solar-powered radio station could be a significant image-maker, a comprehensible notion in the industry. We hypothesized that stations would be more interested in the field test to the extent that they perceived of its image-making potential.

Financial contribution: The Lincoln Laboratory RFP asked for an indication of station willingness to share project cost. The allocation of resources (time, money, and personnel) to one thing over another is often an indication of the relative comprehensibility of each. However, the capacity to make a relative allocation also relates to availability of resources to allocate at any given point in time. We hypothesized that a station's willingness to make a financial contribution to a project would reflect the project's comprehensibility, but also that an unwillingness to do so could also reflect an absence of available resources at the time required.

Figure 1, "Opportunity for Innovation," graphically presents the perturbation introduced by Lincoln Laboratory into the daytime radio broadcasting institutional arena, as well as decision sequences and institutional forces influencing each of the stations.

Given an initial universe of 800+ stations, and a PON response of 103 stations, it was decided to do only indicative sampling of institutional data. A visit to Lincoln Laboratory, and a discussion with the chief staff person involved in designing the project, drafting the PON and RFP, and selecting the list of radio stations which received the first notice about the project, provided us with data on the rationale for the initial sample of stations, as well as copies of all the letters received in response to the PON.

We were also provided with copies of the PON and RFP and materials provided to potential bidders at the pre-proposal conference, and a log of questions phoned and written in by stations who were unclear about how to proceed at each stage.

The letters in response to the PON ranged from perfunctory to rather detailed, and in a number of cases discussed some of the factors which are of interest in this study. Questions posed in the letters and calls also helped clarify particular study issues. Table 1 summarizes information about PON respondents. The "level of interest" category is based on careful reading by the authors of the letters, using factors such as the level of detail, use of language conveying interest and enthusiasm, or expression of specific reasons for interest or questions about the project. The expression of interest did relate to our initial hypotheses. Some focused on the energy aspects. One person wrote that the county which the station serves pays the highest oil prices in the state, and that the project seemed like an important step toward breaking the dependence on high-cost energy. Another station owner wrote that she would be "delighted" to find a source of power other than the local power company. Another letter explained that during the past winter the surrounding area had been snow-bound for days, resulting in serious shortages of fuel and supplies.

TABLE 1

Characteristics of Stations Responding to Project Opportunity Notice (PON)

Station Number	Location	Management	Responder	Apparent Level of In terest
1	ILL.	Other operated	Chief Engineer	One
2	ILL.	Owner operated	Chief Engineer	Three
3	ILL.	Other operated	Pres.	One
4	ILL.	Owner operated	Prog. Dir. for Gen. Mgr.	Three
5	ILL.	Owner operated	Pres.	One
6	ILL.	Other operated	VP/Gen. Mgr.	Three
7	ILL.	Owner operated	Gen. Mgr.	Three
8	ILL.	Other operated	Chief Engineer	One
9	ILL.	Owner operated	Pres.	Five
10	ILL.	Other operated	Gen. Mgr.	Three
11	N.H.	UNK	Chief Engineer	Minimal
12	N.H.	Owner operated	Chief Engineer	One
13	N.H.	Other operated	VP, Gen. Mgr.	One

14	MA.	Other operated	Gen. Mgr.	Four
15	MA.	Other operated	Asst. Mgr.	Five
16	MA.	Owner operated	Pres.	One
17	ME.	Other operated	VP, Gen. Mgr.	One
18	ME.	Owner operated	Chief Engineer	Two
19	VT.	Other operated	Chief Engineer	One
20	VT.	Owner operated	VP	Three
21	VT.	Other operated	VP & Mgr.	Two
22	VT.	Other operated	Chief Engineer	One
23	VT.	Owner operated	Pres.	Two
24	OHIO	Owner Operated	Chief Engineer	Two
25	OHIO	Other operated	Pres.	One
26	OHIO	Other operated	Chief Engineer	Two
27	OHIO	Other operated	VP, Gen. Mgr.	One
28	OHIO	Owner operated	Dir. of Eng.	Two
29	OHIO	Owner operated	Pres. Gen. Mgr.	One

30	OHIO	Other operated	Gen. Mgr.	One
31	OHIO	Owner operated	Chief Engineer & VP Gen. Mgr.	Four
32	OHIO	Other operated	Pres. Gen. Mgr.	One
33	OHIO	Owner operated	Pres.	Two
34	OHIO	Other operated	Chief Engineer	One
35	OHIO	Other operated	Gen. Mgr.	One
36	OHIO	Other operated	Chief Engineer	Five
37	OHIO	Other operated	Gen. Mgr.	Three
38	WIS	Other operated	VP Gen. Mgr.	Four
39	WIS	Other operated	Pres.	Three
40	WIS	Owner operated	Pres.	Three
41	WIS	Other operated	Mgr.	Three
42	WIS	Other operated	Pres./ Gen. Mgr.	One
43	WIS	Owner operated	Mgr.	Three
44	WIS	Owner operated	Gen. Mgr.	Three
45	WIS	Other operated	Pres.	Three
46	WIS	Owner operated	Owner	One

47	WIS	Other operated	Gen. Mgr.	One
48	NY	Other operated	Gen. Mgr.	Four
49	NY	Other operated	Gen. Mgr.	Four
50	NY	Owner operated	Pres.	Two
51	NY	Other operated	V.P.	One
52	NY	UNK	Pres.	Three
53	NY	Owner operated	Chief Engineer	Three
54	NY	Owner operated	Pres.	Three
55	NY	Other operated	Chief Engineer	One
56	NY	Other operated	Chief Engineer	One
57	NY	Owner operated	Owner/Pres.	Five
58	NY	Other operated	Gen. Mgr.	Three
59	NY	Other operated	Pres./Mgr. Chief Engineer	Three
60	NY	Other operated	Pres.	Two
61	Ny	Owner operated	President	Four
62	Conn.	Other operated	President	Four
63	Conn.	Other operated	Technical Director	Three
64	N.J.	Other operated	Chief Engineer	Three
65	N.J.	UNK	Gen. Mgr.	Two

66	N.J.	Owner operated	Chief Engineer	Minimal
67	N.J.	UNK	General Manager	One
68	N.J.	Other operated	Station Manager	Minimal
69	N.J.	Other operated	President	Three
70	N.J.	Other operated	General Manager	Four
71	MICH	Other operated	President	Five
72	MICH	Other operated	Chief Engineer	Three
73	MICH	Other operated	Chief Engineer	One
74	MICH	Other operated	General Manager	Five
75	MICH	Other operated	President	One
76	MICH	UNK	President & General Manager	Three
77	MICH	Other operated	President/General Manager	Minimal
78	MICH	Other operated	General Manager	Three
79	MICH	Owner operated	Manager	One
80	MICH	Other operated	General Manager	Three
81	PENN	Owner operated	President, General Manager	Three
82	PENN	Owner operated	Station Manager	Four
83	PENN	Owner operated	President, General Manager	Three

84	PENN	Owner operated	General Manager	One
85	PENN	Other operated	Technical Rep.	Four
86	PENN	Other operated	V.P.	One
87	PENN	Owner operated	Station manager	Three
88	PENN	Owner operated	President, General Manager	Two
89	PENN	Other operated	Manager	One
90	PENN	Owner operated	President	Two
91	PENN	Other operated	Chief Engineer	One
92	PENN	Owner operated	V.P.	One
93	PENN	Owner operated	General Manager	Two
94	IND	UNK	President	Two
95	IND	Owner operated	Owner	One
96	IND	Owner operated	President	Two
97	IND	Other operated	Vice-President	One
98	IND	Owner operated	President/ General Manager Owner	Three
99	IND	Owner operated	General Manager	Three
100	IND	Other operated	General Manager	Three

101	IND	Other operated	Vice-President	Four
102	IND	Other operated	Technical director	Three
103	IND	Owner operated	Manager	Three

LEVEL OF INTEREST SCALE

ONE	TWO	THREE	FOUR	FIVE
MEDIUM				HIGH

A second type of interest was demonstrated in the form of technical curiosity, and a desire to learn more about the engineering aspects of solar systems. A number of chief engineers wrote and stated their personal interest in the technical aspects of the project. (A few mentioned their connections with MIT.)

A third type of comment in the letters was related to the value of trying new things for the image of the radio station and for educating their listeners. Many related other innovations or modernization efforts that they had undertaken at their stations to demonstrate their commitment to innovation.

Based on this categorization, we chose a sample of thirty stations according to the following criteria:

(1) at least one from each state;

(2) all with 'good' or 'better' interest;

(3) a mixture of owner-operated and other-operated stations.

The respondent sample stations are summarized by the characteristics in Table 2. As the primary interest was in determining the factors influencing the response process to the PON and RFP, with particular interest in the shift from a positive PON response to a negative RFP response, we did not include all of the proposers in the sample, so as not overly to bias it toward innovation adopters. It should be noted that no claim is made for statistical significance of the sample. As an indicative sample, it was drawn to represent a reasonable cross-section of station types, with particular concern for illustration of each type.

A semi-structured, open-ended research instrument was developed for telephone interview purposes. The instrument was pre-tested with two stations not included in the sample, and modifications made as indicated by results of its use. Letters were sent to a contact person at each sample station stating that an interviewer would be calling to discuss the photovoltaic project. Interviews were conducted during January and February 1979.

TABLE 2

Telephone Interview Respondents

Sample Number	Location	Owner	Manager	Officer	Engineer	Managed by Owner	Managed by Other
S1	NJ	UNK					X
S2	NJ	X	X				X
S3	NJ	X	X			X	
S4	CT	UNK					X
S5	NY					UNK	
S6	NY	X	X		X	X	
S7	NY	X	X			X	
S8	NY	X	X			X	
S9	VT	UNK				UNK	
S10	VT		X			X (F)	
S11	MA		X			X (F)	
S12	MA	X	X			X	
S13	ME	X	X			X	
S14	PA	X	X			X	
S15	PA	X	X			X	
S16	PA				X	X (F)	
S17	PA	UNK				UNK	
S18	ILL	UNK				UNK	
S19	ILL				X	X	
S20	ILL			X			X
S21	IND		X				X (F)
S22	IND	X	X			X	

Sample Number	Location	Owner	Manager	Officer	Engineer	Managed by Owner	Other
S23	IND	X	X			X	
S24	QH				X		X
S25	OH				X	X	
S26	MI		X				X
S27	MI		UNK			UNK	
S28	MI	X	X			X	
S29	WI	X	X			X	
S30	WI	X	X			X	
S31	WI	X	X			X	

KEY:

UNK = UNKNOWN (F) = FAMILY INVOLVED IN MANAGEMENT

THE EVIDENCE OF PERTURBATION

There was evidence of perturbation in the institutional arenas of the sample stations in all five of the areas identified for research. Interestingly, we found a sixth area evidencing perturbation, the PON-RFP process itself. This sixth area was a very significant mediating institutional force in station acceptance of the innovation.

Decision structure: The size and/or ownership structure of the station did not seem to be as great a factor as we expected, perhaps because the stations were of relatively uniform size due to their daytime format and power rating. However, there were several types of decision-making processes which did vary depending on the size and structure of the station. The stations managed by owners who were also the chief engineers had the simplest decision-making structure. In those cases, the same person received the PON, assessed the factors involved, and decided whether to request the RFP. In some cases other opinions were sought, such as those of a spouse or partner in the business, or other members of the technical staff. There were also owner-operated stations with a separate engineering staff. In many cases it was the engineers who noticed the project, or who were requested to consider the idea. In these instances, they provided the central input for the decision which was eventually made by the manager. In a number of cases, engineering staff had been stopped from pursuing the project by skeptical managers; in a roughly equal number of cases, an enthusiastic manager had encouraged a dubious engineer to go further with the idea.

In only a small number of cases was the station a part of a corporation so big that the notice of the project was completely lost in the layers of decision-making. However, in two cases it appeared that the larger size of the station made it possible for the company to pursue the project because there were staff people with skills related to proposal writing and who were available to take on such a project. In one case, the proposal was dropped after fairly extensive investigation of cost-benefit ratios, and in the other the proposal was completed and submitted. In situations where owners were not directly involved in the management of the stations, the manager or the chief engineer assumed the proprietary role we hypothesized for the owner-manager; thus the level of interest and concern was still fairly high.

Technical knowledge: The actual technical aspects of the project did not seem to be a major problem for those stations interviewed. In some cases where particular technical difficulties were mentioned (such as a hillside or swamp location), this constituted evidence of technical comprehension. There were some instances of uncertainty about the quality of power generated by PV equipment, but again this evidenced a reasonable degree of technical sophistication on the part of respondents, a sophistication which held true whether the respondent was the station manager or engineer. Most often those interviewed were fascinated with the technical aspects of the project, and were regretful that they were unable to pursue the project for other reasons.

Given the response in this area, it would seem that in low power, daytime radio stations there is a considerable diffusion of technical knwoledge. This may be the result of management personnel often having at least supervisory responsibilities in all three areas. The diffusion of such technical knowledge may also be prevalent in the rest of the industry, because, as was noted earlier, the industry itself is young, and technically based.

Prior information about solar energy: Interest in solar power and specifically in photovoltaics (which we assumed to be more technical, mysterious, and further from public consciousness than solar passive or active solar thermal systems) was very great. Almost all the station personnel contacted mentioned the energy crisis as a subject of grave concern for their areas. Respondents frequently mentioned their interest in furthering new technologies as a contribution toward solving the nation's energy problems. More than a few respondents volunteered opinions about the dangers and inadequacies of conventional large-scale power production technologies, particularly nuclear power and coal, and cited these serious drawbacks as reasons that solar technologies are critical to meeting the nation's energy needs. It was surprising to find the degree of passing acquaintance with solar technologies and the number of test projects, particularly located near universities or schools, which were mentioned by the people interviewed. In summary, solar technology is not a thing of the future to many people, even in the small towns and small businesses represented by many of the stations in our sample. While solar technology may not yet be broadly used, people in broadcasting seem to think of it as a natural next step which will soon be available for wider use.

Image potential: Our hypothesis about the importance of the project's image potential to stations was only partially confirmed. Very few stations mentioned the public relations effects, at least from the standpoint of gaining listeners, as a primary reason for their interest in the project. When asked, almost all stations agreed that it would be helpful to business by giving the station a progressive image. More often, however, stations cited the need to inform people about alternative energy systems and showed an interest in demonstrating that such systems could be used for everyday needs. Only one station expressed the feeling that its listeners would not have any substantive interest in solar or the energy situation; most other stations agreed strongly that listener interest in energy issues was very high.

Financial contribution: Nearly every station stated that the costs of the project -- whether measured in terms of staff time for preparation of the proposal or follow-through, in dollars invested in physical facilities for the project, or in cost/benefit ratios for energy bills -- were too high for them to handle. Repeatedly, respondents stated that they did not fully understand the extent of cost sharing required by or the options available for financial support from Lincoln Laboratory. The belief that the station would be wholly responsible for the costs of developing the site and providing the interface technology stalled several responses to the RFP. The cash flow problem hindered several stations, and in several cases, this was due to recent investments in new facilities or equipment. Many stations did not perceive the immediate return to themselves as equal to the investment they would have to make in capital or personnel time. It was frequently noted that stations might be willing and capable of supplying considerable "in kind" or sweat equity, but that they just could not afford direct capital investment.

PON-RFP Process: An unexpected finding was that the PON-RFP process was itself a considerable deterrent for many potential participants. A variety of reactions to the language, the information, the tone, and the unexpected steps of the project can be summarized quickly as follows: most day-time radio stations are too small to cope with the amount of paper work and desk time required by such a project. Reactions to the tone and language used in the written communications from Lincoln Laboratory ranged from serious hostility ("I'll never work with MIT again," from one station which received a form letter saying its proposal had not been accepted) to a more general impression of a chilly, impersonal, and rather abrupt presentation of the project and its steps.

It seems clear from the conversations with these station personnel that the entire process of notification, requests for proposals, and development of projects on paper is the single aspect of this perturbation most distant from their routine. Very few of the stations appeared to have familiarity with the meaning and form of a "proposal." In fact, our review of the proposals eventually received by Lincoln Laboratories lead us to the conclusion that they were, almost without exception, far from "professional." The very people who were by training and nature most interested in the project -- station engineers in most cases -- are those who are least likely to have wide experience with writing such proposals and/or handling such paperwork. For them, the process of maneuvering through proposal preparation and funding is much less comprehensible than solar technology.

ANALYSIS OF FINDINGS

The findings presented in the preceding section reveal a considerable capability on the part of small, daytime AM radio stations to deal with technologically-based information about solar energy, coupled with a strong commitment on their part to encourage its broader use. Many revealed a considerable familiarity with solar energy applications, but did not view its use in their setting as primarily contributing to their station's image. Stations had limited financial capability for involvement in the project, but were even more confused as to the project's demands on their resources because of their unfamiliarity with the PON-RFP process. In general, then, one can conclude that the broadcasting institutional arena is receptive to solar innovation, but will not move rapidly to adopt it if it is encouraged in ways comparable to federal procurement practices. A point-by-point review of these general comments follows.

The hypothesis relating to decision structure was not disproved, but neither could it be fully confirmed. The reason for this conclusion is that the sample turned out to be fairly homogenous, despite efforts to have clear categories representing various levels of complexity of decision structure. The owner-operated stations did evidence the expected streamlined decision structures. It turned out, however, that absentee-owned stations had similar structures, with the manager or engineer assuming the proprietary role. Of the four clearly identifiable instances of corporate decision structures, we found two in which the project was "lost in the system" (our expected outcome), while the other two were cases where corporate resources made it possible to do the groundwork to submit a response (in one case), or investigate in detail the feasibility of a response (in the other case).

The hypothesis regarding the influence of technical comprehension of the decision-maker on interest in project participation was confirmed. Interestingly, the small size of the stations may have contributed to the decision-maker having a technical sophistication. It is clear that, when compared with studies in other institutional arenas such as agriculture and housing, the technical aspects of the innovation themselves promote, rather than hinder, PV acceptance.

The hypothesis that prior information on solar energy increases comprehensibility (and therefore interest) was also confirmed. Indeed, there was a relatively high level of knowledge about solar demonstrated by the respondents. It may well be that because broadcasting deals with information (especially timely information), there is a greater sensitivity on the part of these individuals to publically-supported innovation. Whatever the reason, it was clear that this factor was the most significant in spurring active interest and effort on the part of station decision-makers regarding the Lincoln Laboratory project.

The importance of solar energy per se was clearly evidenced in the relative unimportance of PV to respondents for its potential contribution to station image. PV's attributes as an energy source for the country were sufficient to make it comprehensible; it did not need the added comprehensibility of contributing to a station's market share to enable respondents to make it part of their routine decision process.

The one factor which outweighed the favorable attributes of the technical and energy dimensions of PV was the incomprehensibility of the resource allocation decision required by the project. While respondents talked about this in terms of cost, it was evident that their difficulty stemmed from an inability to understand how to handle the PON-RFP process (what is referred to in some circles as "grantsmanship"). This tended to be expressed by uncertainties about what Lincoln Laboratory's cost-sharing requirements were, as well as by frustration and even anger over the form and language of the communications they received from Lincoln Laboratory. Typically the response was confusion ("I don't understand what they mean") or incredulity ("How can they say that!") Thus, despite a strong disposition to want to be involved in the project, many dropped out, deciding that they could not justify being involved in the project.

This last reaction is interesting evidence of how often money is the proxy variable for a host of others. Here, it is not so much the actual expenditure of funds which is the barrier, but rather a lack of comprehension about what it would mean to spend the money. In such situations, the use of a subsidy or grant may eliminate the need to think about the financial issue, but quite probably will not eliminate the institutional factors which contributed to the lack of comprehensibility which is referred to as a "cost problem". It is quite possible that many more stations would have submitted proposals including provisions for cost-sharing if, for example, (1) the interest solicitation process had been in a form or tone of language more consistent with their daily routine, and/or (2) a mechanism for technical assistance in completing the steps of the proposal process were readily available.

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