ASSESSING THE CONSUMPTION BENEFITS OF L.I.S. PROJECTS

BY C.H. WEIR AND R.B. SWETNAM

ABSTRACT

An understanding of the nature and extent of the benefits of L.I.S. projects is essential for making informed investment decisions about them. This paper examines the two major types of benefits generated by L.I.S. projects - production benefits and consumption benefits - and outlines a procedure for investigating consumption benefits.

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One of the most difficult aspects of making investment decisions regarding land information system projects (L.I.S.) is assessing the benefits which are likely to result.[1] The benefits of L.I.S. projects are difficult to define and even harder to measure. Nevertheless, if we are to justify the considerable costs of these projects and make informed investment decisions about them, an assessment of benefits is essential. The purpose of this paper is to suggest one procedure for investigating and assessing the benefits associated with L.I.S. projects.

Before developing such a procedure, however, it is useful to first examine what is meant by the term "benefit" and to identify the types of benefits which can be expected from an L.I.S. project. In general terms, a benefit is any result of an action or project which is considered desirable, while a cost is a result that is undesirable. In economic terms, a benefit may be thought of as the desirable result of a project or action which improves the welfare of a community, organization or individual by increasing the opportunities to consume and/or produce goods and services. Similarly, a cost is a result of a project which reduces opportunities to consume and/or produce goods and services.

There are two major ways that an L.I.S. project may produce benefits. The first is by reducing the cost of producing land-related information. We shall refer to these as production benefits. By reducing the cost of producing land-related information, the L.I.S. project makes available for other uses resources which, in the absence of the L.I.S. project, would have been used in the production of land-related information.

The second way that an L.I.S. project may generate benefits is by increasing the consumption value of the land-related information. We shall refer to benefits generated in this way as consumption benefits. Consumption value is simply the value which consumers place on consuming a good or service. The amount that consumers are willing to pay for a product or service does not depend on the cost of producing it. Rather, it depends on the satisfaction or the utility that they receive from it.

A single L.I.S. project may generate both consumption and production benefits. Consider the example in which a government undertakes an L.I.S. project to computerize land registry which contains information on the ownership and valuation of land. Figure 1 represents situation before the L.I.S. project is undertaken. The demand curve d_1 shows the amount of this type of land-related information that consumers are willing to purchase at various prices. The curve is downward sloping indicating that as the price of the information decreases, the amount demanded increases. The supply curve at P_1 shows the price at which the government is willing to sell land-related information. For the purposes of this example, assume that there are no economies of scale and that the government is willing to sell land-related information at cost. Thus P_1 is also the cost curve for the government.

Let us now assume that as a result of the L.I.S. project, the cost of producing and maintaining land records is reduced due to increased effeciency resulting from computerization. This is represented in Figure 2 by the downward shift in the supply curve from P_1 to P_2. As a result of the L.I.S. project, there would be a saving on the production of the original volume of messages that was produced. This saving would be a production benefit and is shown by the area "abcd". This area represents the cost saving on the production of each message (P_1-P_2) multiplied by the original volume of messages (M_1).

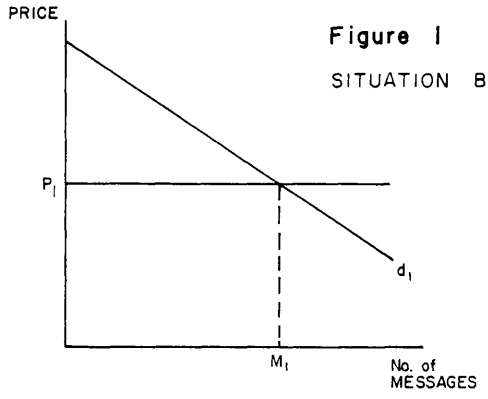

Figure 1

SITUATION BEFORE L.I.S. PROJECT

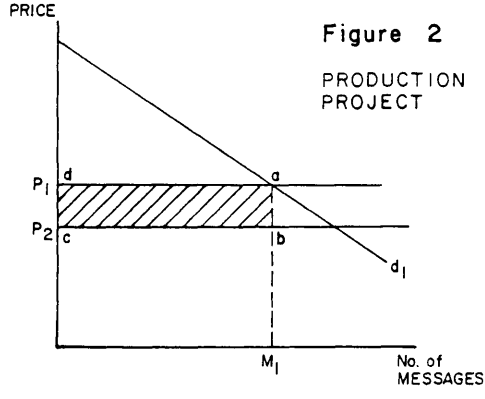

Figure 2

PRODUCTION BENEFITS OF L I S PROJECT

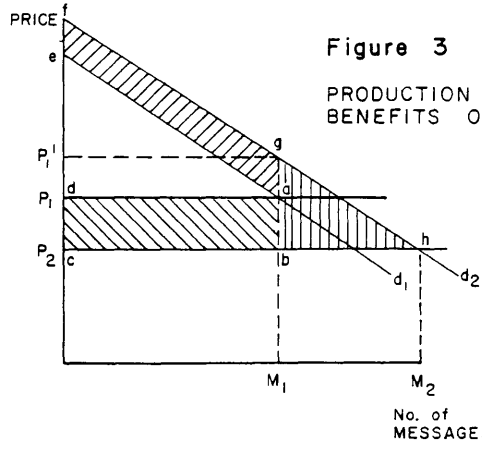

Figure 3

PRODUCTION & CONSUMPTION BENEFITS OF L.I.S. PROJECT

Let us say that as a result of the L.I.S. project, the information about land records that is produced by the new system is more accurate and current and that it can be combined directly with land-related information found in other data bases. Let us assume also that consumers are willing to pay more for land record information as a result of the improvements. This is reflected by an upward shift in the demand curve from d1 to d2. Figure 3 shows that consumers are now willing to pay an additional amount (P_1'-P_1) for each message that they receive. The additional amount that consumers are willing to pay for each each message (P_1'-P_2) multiplied by the original volume of messages (M_1) is a consumption benefit produced by L.I.S. project which is realized on the initial volume of messages. This is represented by area "aefg" in Figure 3.

Because the land record information costs less to produce and purchase and because each message is now more valuable than before the L.I.S. project was initiated, this means that the amount of information demanded and supplied will increase to M_2 messages (See Figure 3.) This is the amount at which the new demand curve d_2 and the new supply curve P_2 intersect. The cost of producing this additional information is represented by the area "bhM_2M_1". This is the new cost of production P_1 multiplied by the additional volume of messages M_1-M_2. The value to consumers of this additional volume of messages is represented by area gM_1M_2h which represents the total amount that they are willing to pay for this information. The triangle "gbh" represents the surplus to consumers or the consumption benefit realized from the additional volume of messages.

Determining the production benefits on the original volume of messages is a relatively straight-forward though by no means simple task. The analyst must first determine the period over which the benefits would be realized Next, the costs of implementing the project and operating the system are estimated over the relevant period. Future costs are discounted and expressed as present values. Next, the costs of producing the information over the relevant period in the absence of the project in the absence of the project are estimated and discounted to their present value. The difference

between the total production costs under current conditions and those assuming that the project was undertaken is the value of the cost savings or production benefits that would be realized on the orignial volume of information as a result of the L.I.S. project.

To estimate the consumption benefits which would result from the L.I.S. project, the analyst must determine the additional amount that consumers are willing to pay for the land-related information as a result of the L.I.S. project. In normal markets, the amount that consumers are willing to pay for goods and services is reflected in market transactions. By observing market transactions we can tell how much consumers are willing to pay for various quantities of a good or service. For land-related information, however, there is a problem in that there are very few developed markets from which we can obtain information about consumers' willingness to pay. Those markets which do exist are highly distorted by monopoly and government subsidies.

Since it is impossible to determine from market transactions what consumers are willing to pay for land-related information, another means of determining the benefits which they derive from this information must be used. What we must do is to is to investigate how consumers would use the information resulting from the L.I.S. project and ask them about the nature and magnitude of the benefits that they would derive. While this seems very straight-forward in theory, in practice it is a very difficult task.

The reason for this is that it is extremely difficult to determine all the ways that consumers might use a land information system and the information that it provides. By nature, land information systems, especially the ones developed in recent years using data base technology, are open-ended. That is, they are designed to accomodate multiple applications which may or may not be known when the system is being developed. It is quite possible, for example, that a land information system that was developed to provide cadastral information may be expanded and used extensively for transportation planning.

Another reason that it is difficult to determine how many land information systems will be used is that L.I.S. technology are developing so rapidly that the uses and potential of this technology is unfamiliar to consumers. Although new applications for this technology are being constantly discovered, it will take years of experimentation by consumers before we will be able to say with any degree of confidence how these systems are likely to be used.

Because it is difficult to determine how consumers will use the land information systems that are being developed, it is even more difficult to determine the benefits that they will derive from these systems or the value that they derive from the information that is produced. As one observer has stated:

> "In practice, it is a formidable task to try to measure the value of information to ultimate users. It is difficult to identify all the types of decisions in which land information is used. It is even more difficult to establish the ways in which individual decision makers process the information. And, it is extremely difficult to specify how changes in the form of the informaton will alter the individual decisions made."[2]

Despite these difficulties, it is essential that we understand how a land information system will be used if we are to investigate the consumption benefits associated with the L.I.S. project.

In the remainder of this paper, we shall describe a procedure for investigating the consumption benefits of L.I.S. projects. This procedure is part of a larger procedure for undertaking cost-benefit analysis of land information systems that was developed by Stewart, Weir & Co. for the Government of Alberta, Canada which is currently in the process of developing a network of land information systems in the Province.

In order to determine the consumption benefits generated by the L.I.S. project, we must question potential consumers about their reaction to the changes in the output of land-related information that would occur as a result of the project. This in turn requires that the analyst have a clear understanding of what those changes would be and to communicate these changes to those whose reaction to the changes is being sought.

Often the changes to the outpout of land-related information are not obvious to either the developer of the land information system or to the analyst. Small changes which might be very important to the consumer may appear as trivial to the analyst or the system developer and not be communicated to consumers. If these changes are not communicated, however, it will be impossible to get a realistic assessment of the consumption benefits that would be generated.

In analyzing changes to the output of land-related information which would result from the L.I.S. project, it is useful to view land-related information as a product (the L.I.S. product) and the distribution of that information to consumers as a service (the L.I.S. service). As with any other product or service, the L.I.S. product and service have certain characteristics or features which determine their attractiveness to consumers.

To help identify the features of the L.I.S. product and service, the following checklist was developed. This checklist breaks the features into major categories and suggests a number of questions which should be asked for each category. The L.I.S. product, for example is divided into features which describe the content of the land-related information and those which describe the way in which that information is related to a position on earth (see Figure II). With respect to the content of the land-related information the following categories and types of questions were suggested:

FIGURE II

CHECKLIST

L.I.S. PRODUCT/SERVICE FEATURES

FEATURE CATEGORIES	CURRENT SITUATION	AFTER L.I.S. PROJECT
L.I.S. PRODUCT Content Subject Matter Accuracy Temporal Characteristics Compatibility - Graphics Format Report Format Spatial Referencing Mode Accuracy Resolution Areal Coverage		
L.I.S. SERVICE Mode of Access Output Devices Security and Privacy User Data Analysis Capability Response Time		

Subject Matter: How would the L.I.S. project change the subject matter or the content of the land-related information that is currently available? Would new types of information would be created?

Method of Data Collection: How would the L.I.S. project change the way in which the data was collected upon which the information is based? For example, if the information was statistical, what sort of survey methods were used? How would this be different from they way that the data is currently collected if it is now collected?

Graphics Content: To what extent would the L.I.S. project affect the graphical representation of land-related information? What forms or graphical output would be made available?

Report Format Characteristics: How would the L.I.S. project change the format in which standard reports were made available?

Accuracy: How accurate would the land-related information produced as a result of the project be? Is this more or less accurate than what is currently available for this type of information? Have standards of accuracy been established? Would the level of accuracy of the information be made known to the user? Would the level of accuracy be consistent or would it vary?

Temporal Characteristics: To what time periods would the land-related information refer? Would time series data be available? How often would the information be updated? How recent or up-to-date would the information be? How does this compare with the temporal characteristics of this type of land-related information if it is now being produced?

Compatability: With what other types of data bases could the L.I.S. product information resulting form the L.I.S. product be compared with? For example, if the information describes various characteristics of the population according to age and geographic location, to what extent are the age categories used compatable with age categories used in other information bases. What are the major types of cross-referencing with other data bases that would be possible as a result of the L.I.S. project?

By its very nature, land-related information is information that is referenced spatially. The L.I.S. product may also be described in terms of the features which describe the way that it is related to a position on the earth. With respect to the spatial-referencing characteristics or features of the L.I.S. product, the following types of questions are suggested in the checklist:

Mode of Spatial Referencing: How would the L.I.S. product be referenced spatially? (e.g. by survey co-ordinates, administrative boundaries etc.) How would this differ from the way that this type of information is currently referenced spatially if it is available?

Accuracy of Spatial Referencing: How accurate is the system by which L.I.S. product would be referenced spatially. How accurately is the L.I.S. product referenced within that system? How does this differ from current levels of spatial referencing accuracy for this type of land-related information.

Resolution: At what degree of resolution is the system by which the L.I.S. product would be referenced spatially? How would this differ from the current situation?

Areal Coverage: How broad an area of the earth would be covered by the L.I.S. product? How would this differ from what exists currently?

With respect to the features which describe the L.I.S. service, that is the way in which the L.I.S. product is made available to consumers, the following questions are suggested:

Mode of Access: Could the information be accessed by remote users? If so, how would the information be transmitted and received? Would there be a limited number of remote terminals in designated offices or could the information be accessed via modem over telephone lines, for example? What type of hardware or software would be required to access the system? How would this compare with the current situation?

Output Devices: How would the L.I.S. project affect the type of devices by which the L.I.S. product would be displayed? Would special printers or plotters be required to produce hard copy of the information? If so, what type would be required? Could the information be displayed in colour? What ranges of colour would be available?

Security and Privacy: What types of users would be able to access the information? What protection would there be against accidental or intentional disclosure to unauthorized persons or unauthorized modifications or destruction of data? What restrictions on access would be placed? How would this differ from the current situation?

User Data Analysis Capability: To what degree would those receiving the L.I.S. product be able to manipulate that information or perform functions such as distance and area calculations, statistical analysis, buffering, Boolean logic analysis, route selection, digital terrain analysis, site line analysis, and pattern recognition? How would this compare with their current ability to perform such functions?

Response Time: How long would the average response time be for receiving information from the system? How would this compare with current average response times for receiving this type of information?

Once the changes to the output of land-related information have been defined, the next step is to determine the potential users of the L.I.S. product and service. Most L.I.S. products will not involve the creation of entirely new land-related information but rather the modication of information presently available in some format. The first step in identifying potential users should be to contact the producers of this information and various experts in its use to determine who are the major current consumers. The various user groups should be identified and ranked according to their level of usage.

Next, the features of the L.I.S. product should be communicated to the producers and experts and they should be questionned about other possible user groups among the current users of this information. To help in this identification, it is useful to scan a standard industrial classification. A standard industrial classification is a systematic, comprehensive listing of all sectors in the economy, including the government. The Standard Industrial Classification of Canada, for example, divides the economy into 18 major economic divisions each of which is broken into major groups, groups and classes. By scanning the appropriate parts of this classification, it may be possible to identify potential user groups which otherwise might have been forgotten.

The next step is to identify the size and major characteristics of each current and potential user group. For this, various government and private sources may be consulted. In Canada, private sources such as Scott's Directories, Dun and Bradstreet, and Moodies provide extensive information about the numbers, names, and adddresses of companies according to their SIC code and location. In most cases, potential government users of the product will have to be identified by contacting the relevant department and agencies. Once the major consumer groups for the L.I.S. product and servie have been identified, the next step is to conduct interviews with a small, though representative, sample of consumers.

It is important to have personal discussions with the potential consumers in order to develop an understanding of the practical problems associated with the use of the L.I.S. product and service. Personal discussions also help to avoid naive assumptions about the benefits produced by the L.I.S. project. Through personal discussion with those who will be using the title information including the farmers and bankers, many of these factors can be identified. The findings of these discussions can help the analyst to avoid naive assumptions in the measurement and analysis of benefits at a later stage. They are also useful for showing what other actions must be taken in order to realize the expected benefits of the L.I.S. project.

Feedback from potential users of the L.I.S. product is obtained through the Focus Group interview. The Focus Group Interview is a technique used by marketing professionals for developing and testing new products. A typical interview involves a Focus Group leader and 6 to 8 participants who are all members of the user community. Typical sessions last between two and three hours. The leader's role in the interview is critical. He or she must carefully plan the meeting and determine the important issues and questions to be discussed. During the meeting, the leader must lead discussion without being too directive. The leader should do as little talking as possible and make sure that all participants contribute to the discussion. Finally, the leader must have a good understanding of the features of the L.I.S. product.

The number and format of the focus group interviews required depends upon the variety of potential users, the type of decision to be made and the budget available for the study. If it is felt that there are a few large users of the L.I.S. product, it is advisable to conduct one interview per industry where there are only members of the same industry present. If the major users come from a large number of different industries, then it may be necessary to have a mixture of several industries at each interview.

While the format of the session may differ, each Focus Group Session should have three major parts. In the first part, the focus leader should question the participants about how they are currently receiving and using the relevant types of land-related information. Needs will be identified and the satisfaction with the current system should be explored.

The purpose of the second part of the meeting is to communicate the features of the product to the participants. The articulation of features which was done in the previous stage should help to Focus Group leader to structure his communications. Depending upon the degree to which the product concept has been developed and the nature of the product, it may be useful to group various features together and/or present a few features as options.

It is important that the presentation of the L.I.S. product and service be as clear and succinct as possible. In come cases, it may be very useful to demonstrate how the L.I.S. project would actually work using prototypes or mock-ups of the system. This makes it much easier for the potential user to comprehend the product and react to it. It also makes it much easier to identify required changes to the product at an earlier stage of development when such changes are much easier. For this reason, prototypes of the product should be demonstrated wherever possible.

The purpose of the third part of the focus group session is to get the participants' reaction to the product which is being proposed. Once the focus group leader is certain that the participants understand the concept, he will ask a series of questions in regard to the new system to determine from the participants:

- their reaction to the various features of the L.I.S. product;
- the factors that would affect their usage of the L.I.S. product;
- the probable extent of their use of the L.I.S. product;

- the savings or increased revenue that they feel they could realize in their current practices through use of the L.I.S. product.

At the end of these interviews, the findings should be tabulated. At this point, the analyst should have a general understanding of the major ways that the L.I.S. product and service would likely be used and the benefits associated with those uses.

Presentation

If the findings of the benefit study are to be useful in the desicion-making process, they must be clearly understandable to decision makers. If the findings are buried in a mass of extraneous detail, it is likely that the procedure will be of little use to decision makers. For this reason, the presentation of findings is extremely important.

At this stage a concise, well-organized and easily-referenced report should be prepared which communicates to the decision maker:

1. The nature of the L.I.S. product and service and how they will likely be used;

2. The magnitude, timing and distribution of the costs and benefits associated with the project;

3. A general indication of how the measurements of benefits were arrived at and a general indication of their reliability.

It should be stressed at this stage that in presenting the findings of cost-benefit analysis, the purpose is not merely to transmit the findings of analysis but to communicate them in such a way that will help decision makers to make their own evaluation of the project under consideration.

Conclusion

In this paper, we have suggested a procedure for investigating the benefits of L.I.S. projects. It is anticipated that the procedure will be tested as the Government of Alberta proceeds with the development of its network of land information systems. The measure of the success of the procedure will be the degree to which it helps government decision makers to make informed investment decisions about L.I.S. projects.

FOOTNOTES

1 An L.I.S. project is defined as any action which is undertaken in order to create or modify a land information system. A land information system is defined as: "a tool for legal, administrative and economc decision making and an aid for planning and development which consists on the one hand of a data base containing spatially referenced land-related data and on the other hand of procedures and techniques for the systematic collection, updating, processing and distribution of data. The base of a land information system is a uniform, referencing system for the data in the system, which also facilitates the linking of the data within the system with other land-related data".

The definition of the term land information system has been the subject of considerable discussion in recent years. (See for example A.C. Hamilton and J.D. McLaughlin ed., (1985) The Decision Maker and Land Information Systems, The Canadian Institute of Surveying). Distinctions have been made between land information systems, geographical information systems and spatial information systems. While these distinctions may be important for some purposes, we shall consider them to mean the same thing for the purposes of this paper.

2 Pamela Angus-Leppan, (1983), "Economic Costs and Benefits of Land Information" in Publication of the 17th Congress of the International Federation of Surveyors, Commissin 3: Land Information Systems, Sofia, Bulgaria, p. 309.2/14.

3 Stewart, Weir & Co., The D.G.S. Cost-Benefit Procedure: A Manual for Undertaking Cost-Benefit Analysis of Land Information Systems, Alberta Bureau of Surveying and Mapping, 1985.